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The Electric Light Convention.

It may be doubted whether the National Electric Light Association has ever gone through a more eventful and useful week than last. The programme presented was one of unusual practical merit, and it was carried out in excellent style. Despite the strong attractions outside, the meeting room was well filled and the discussions, not less than the papers, were admirable. The mere fact that the convention was held in connection with an electrical show under the auspices of the association, would have sufficed to mark the week with distinction, but when we note that the programme included also an automobile ride, a lecture on liquid air and a trip to the great works at Schenectady, it will be seen that the meeting will go down into history with an eclat equal to that of 1896. President Young has every warrant for feeling proud of the manner in which his able and energetic management was brought to so brilliant a close.

The Automobile Ride.

Standing out prominently among the events of the electric light convention last week was the sucessful automobile ride given on behalf of the ladies, when nearly fifty electric carriages with a party of over 120 people visited Grant's Tomb and Columbia University. For the first time in its history the Association was thus brought into real touch with the new art with which it will soon have so much to do, and the impression made on the members was instantaneous and deep. A few of them had realized the concreteness and importance of the new development, but to most of them the subject was one wearing the air of a remote novelty. Many of the ladies had never ridden in an automobile; some had actually never seen one before. Under such circumstances, the triumphant march of that long line of elegant carriages out and home, under conditions about as severe as they could be made, was an event full of significance and gratifying to all who participated in it.

There were many features of special interest in the affair. The members of the committee organizing the trip were seriously dissuaded from it because of possible failure and accident, and in fact met opposition where they might well have anticipated warm encouragement. The attitude of the city authorities was by no means helpful, while the Park Board maintained the hostility towards automobiles that has always characterized it. As for the trip itself, although a line of travel sufficiently taxing had been laid out up to the heights that look down on the whole city, the policemen in charge of the line insisted on heading it, at the end of the route, into a series of three sharp hills with dirt road and intersected by two broken up street car tracks. If there was any plot in the manœuver it was well planned, but failed most miserably, the carriages as a whole, laden with more than their wonted quota of passengers, responding splendidly to the call.

As for the unconcealed dislike of some of the members of the

Park Board toward automobiles, it must be borne with for a time. At the present moment, they will not allow an automobile to enter Central Park, and would make no exception on this occasion. They are welcome to the part of Mrs. Partington in brooming back the Atlantic, but we recommend them for the attention of the new Automobile Club that has already been called into being by the remarkable success of last Wednesday's trip. The club has much work ahead of it, but it may as well begin its siege of the medieval New York Park Board right now, and fight to a finish the question of the equal rights of automobiles.

PHASE-ANGLE MEASUREMENT.

The correspondence appearing in this number upon the subject of phase-angle measurement has important bearings upon the practical measurement of power delivered to consumers on three-phase systems. A practical central station manager cannot afford to forget the subject of difference of phase in dealing with meters for the registration of energy delivered, and a mistake or oversight in this direction may be fraught with financial loss. In the star triphase system, there is a neutral point, which is really of neutral or zero potential in systems of balanced power, and which approximates more and more closely to zero potential as the power is more nearly balanced. Any such balanced system is obviously symmetrical with respect to the neutral point, which might just as well be connected to ground during the normal operation of the system, so far as it could affect any of the operations involved. The imaginary grounding of the neutral points at both sending and receiving ends of a star triphase circuit obviously splits up the system into an equivalent combination of three independent single-phase circuits with ground return, and a wattmeter in each circuit with its series coil in the line and its shunt coil connected to ground or neutral point, obviously measures the real power delivered on that line. Consequently, three times the indication of any such wattmeter would give the total power delivered on the balanced triphase system.

With the delta triphase system, however, no neutral point exists, and the use of the above-mentioned method of measuring power is precluded. In this case two different plans are in use. The first is to make an artificial neutral point by the use of high non-inductive resistances either inside or outside the wattmeter, and connect the shunt coil to this neutral point as before. The second is to discard the neutral point entirely, and to take the pressures and currents supplied to the star load. A single wattmeter with its series coil in one line and its shunt coil between adjacent lines, will give only half of the total power supplied by the triphase system when the power-factor is unity; and if, as is commonly the case, with motors in circuit, the power factor is considerably less than unity, the reading of the wattmeter may be anything from 0 to 100 per cent. of the power of the system. In other words, a single meter used in this way may be quite useless. A pair of meters, each connected on one side of the system will, however, give by the sum of their readings the total power supplied to the system, no matter what the power factor of the load may be; or, if one meter can be placed with its series coil in one line and its shunt coil tapped to the middle point of the opposite side of the delta, it will indicate just half of the real power of the balanced system, no matter what the power factor may be.

The conclusion to be drawn is that the ordinary wattmeter, or watt-hour meter, may be properly calibrated and be operating in good order and yet not give reliable indications of the power or energy delivered on a three-phase circuit, unless properly installed. If, however, the meter is calibrated as a triphase system wattmeter with special reference to the circumstances of its use, then when properly connected to the system it should be held responsible for the proper indication of the power delivered by the system. The central station operator should carefully distinguish between the two classes of instruments. The former is really a single-phase instrument used in a three-phase system and interpreted intelligently. The other is a specially designed triphase instrument for obviating the necessity of any reduction or interpretation.

THE USE OF REACTANCES TO LIMIT OVERLOADS.

With the comparatively small generators of early installations and their circuits of comparatively high resistance, short-circuits were rarely supplied with sufficient power to do any material damage, and the breaking of the current in case such lines became short-circuited was a matter of no great difficulty. As the large low-tension networks developed and machines capable of delivering several thousand amperes were connected to them, it became possible to burn out any ordinary short-circuit and thus automatically remove the cause of trouble, often without the necessity of discontinuing the supply. Circuit breaking devices, especially fuses, in the main arteries of such systems were therefore largely abandoned. With the growth of systems supplying many thousand kilowatts on high-tension circuits carrying 5,000 to 25,000 volts, new conditions arise. A short circuit does not burn itself out as does a low-tension short circuit, because the high voltage will persist across a very wide gap, once a path of vaporized metal is established. The high tension renders the amount of power which can be supplied through the resistance of a feeder short-circuited at its distant end, enormous, and modern machines, built for close regulation with a large overload capacity and a very large amount of stored energy in their flywheels, are well filled storehouses from which this energy may be drawn.

Taking the plant now being erected by the Metropolitan Street Railway Company, of New York City, as an example, there will be a battery of generators all working in parallel on one set of bus-bars with an aggregate rated output of 50,000-hp at 6000 volts, and an enormous overload capacity owing to the close regulation for which the machines were designed. The switchboard of such an installation can be guarded against accidental cross-connections with sufficient care to render their probability very slight, but the same is hardly true of the extensive network of feeders which must radiate therefrom. Taking the case of a feeder designed to deliver 2500-hp with an ohmic drop of 5 per cent., a burn-out at its distant end would short-circuit the system through a path which would permit the passage of about 50000 hp and proportionately more if the short-circuit occurred nearer the station. The ruinous violence of such a burn-out at the point where it occurred, as well as to the whole feeder and to the continuity of the supply, is borne out by experience already obtained under similar conditions, and the difficulty of opening such an enormous load at such a high voltage is a very perplexing one.

In a paper presented by Mr. W. L. R. Emmet, before the National Electric Light Association, an abstract of which will be found on another page, there is suggested the use of reactances for limiting the total amount of power that can be delivered from a center of supply to individual branches. Owing to the vectorial combination of an inductance with a resistance in determining the flow of current through a circuit, the addition of considerable inductance to an otherwise non-inductive circuit affects but slightly the working under normal conditions, but immediately checks any considerable increase above the full load output. For example, a properly proportioned

inductance which would diminish the flow of current through an otherwise non-inductive circuit by only 5 per cent., would prevent more than three times the same amount of current from flowing through it were all the resistance in series with it short-circuited. In such a case as that above mentioned the supply of a railway system through rotary converters the inductance is invaluable in that it allows the over-compounding of the rotary converters through the reaction of leading or lagging currents, and the placing of this inductance where the feeder branches from the switchboard instead of at the sub-station, simply makes it serve another useful function—the protection of the feeder from a violent short circuit.

THE CONVENTION PAPERS.

The programme of papers read before the recent Convention of the National Electric Light Association was almost an ideal one. The subjects were entirely practical, and without exception the treatment was such as to appeal to the audience before which they were read. It is true that some of the papers referred to plants of such a size that the direct application of the information conveyed was limited to but few central-station men, but the general value was nevertheless high, as the papers dealt with the very latest developments in central-station engineering, and brought before the owners of even small plants problems which one day they may, in some form, have to meet. The papers on transformers by Prof. Goldsborough and Mr. Hubley were particularly apropos, as the question of the ageing of transformers is a comparatively new one, and the source of information on the subject has heretofore been that of the manufacturer of transformers and not the user. The experiments of Prof. Goldsborough showed that transformer manufacturers have been able to eliminate the trouble known as ageing, at least between the limits of the temperatures of his experiment. While these temperatures were sufficiently high to cover all ordinary cases, yet, as pointed out by Prof. Robb, the ageing effect might have appeared in the same transformers if heated to a higher degree. In such cases, however, Mr. Hubley showed that the central-station manager at reasonable cost can himself correct the evil by reannealing the cores. One of the subjects which, judging from the discussion, appeared to have the most interest to those present at the meetings, was that of series alternating-current arc lamps. The evidence given in favor of this system by Prof. Robb and others was so satisfactory, that probably few members went home without having in their minds the plan to give it a trial when the opportunity offered.

That the electric lighting fraternity has not yet entirely recovered from its former strong penchant for "systems," was made evident in the discussion on the several papers descriptive of plants, queries indicating that by some the alternating and direct current are yet considered in the light of rivals in the central-station field. The answer was invariably that the conditions of each case decided whether the direct current or alternating currents, single or polyphase, or a combination, were the best; in other words, that central-station engineering is no longer at matter of systems, and a manager should be guided in his decision when the matter of extensions or transformations come comes before him, by an engineer and not, as formerly, by a manufacturer or advocate of a system. The papers by Messrs. Wagner, Robb, Leslie, Barstow and Ferguson gave a view of the latest central-station engineering with reference to large plants, such as could not have been procured from any other source. They not only point out what has been done in the cases to which they refer, but will be found extremely suggestive by managers of all central-station plants, and particularly by those faced with the necessity of making radical changes.

Without doubt the most important paper presented before the convention was that of Mr. Emmet, as it dealt not only with the new problems introduced by the use of high voltages, but gave definite information for the solution of one of the most important—the means of safely breaking high-voltage circuits. It also brought forward the old question of grounding the neutral, which, however, has assumed new importance in view of late developments, including the introduction of the rotary transformer as a link in the chain of secondary distribution. The immediate result of Mr. Emmett's remarks on this subject and the discussion which followed, was action taken by the association having for its object the bringing about of a change in those underwriter' rules which now prohibit the grounding of lighting circuits.

WATT-METERS VERSUS WATT-HOUR METERS.

It is very common to designate a recording watt-hour meter, say of the regular Thomson-Houston type, as a recording wattmeter. The designation may serve to indicate the instrument quite clearly, but it is none the less incorrect. If we attach a centrifugal indicator to the axle of a carriage, as is sometimes done in test-cars on electric railways, the apparatus may be calibrated to indicate the speed in miles per hour, and is a speed indicator. If we connect this speed-indicator through gear wheels with a counter or register, so that it shall integrate the speed throughout time, the result indicated would be distance in miles traversed. In this case, speed is the analogue of rate-of-working or power, as measured in watts, while the integrated result in time, is distance and corresponds to the total energy integrated, or watt-hours. It would be obviously ridiculous to call a bicycle cyclometer a speed recorder, because it does not record speed—it only records distances. It is just as ridiculous to call a recording energy meter a wattmeter—since it does not record watts—it only records watt-hours. It is often urged that such criticism is hypercritical, and that no harm can follow the incorrect use of the term registering wattmeter, while the pedantic effort after accuracy in the term watt-hour meter may lead to ridicule and confusion. The fact is, however, that it is just as easy to be correct as to be incorrect, and, moreover, the looseness with which we use terms is apt to recoil upon our own heads through the serious errors that may follow, either by oversight in habit, or by misleading others. When we mark upon the nameplate of an instrument a misleading title, we not only tempt those who know better into loose language, but we also plant an erroneous impression into the minds of those who do not know better, and make the task of technical education by so much the more difficult.

It is sometimes urged on behalf of commonly misused terms that their continued use is justified by the general voice or the majority vote. This is always a just plea if the statistics as to the general use will bear out the allegation. Thus, it has been claimed by philologists that the term "electrocution" is altogether wrong from the standpoint of language and is a meaningless word. That might be true before the word came into use and might be a reason for avoiding the use of the word. But at the present time the word is so extensively employed that it bids defiance to its legitimate birth. The case is different, however, in the domain of physics when a correct and an incorrect term are both applicable to the same thing. It must always be wrong to call a bicycle cyclometer a speed meter so long as speed is accepted to mean rate of motion. It can only under any circumstances be correct to call it a speed meter, when speed shall have ceased to mean rate of motion. In the same way, so long as the watt is agreed to mean a rate of working, it is quite impossible for the term "recording wattmeter," correctly to apply to a watt-hour-meter, which is a particular kind of joule meter.

First Annual Convention of the Southwestern Gas, Electric and Street Railway Association.

THE first annual convention of the Southwestern Gas, Electric and Street Railway Association was held in Austin, Texas, May 17, 18 and 19, there being over 100 delegates present. The association was organized at Laredo, Texas, in March, 1898, and is an amalgamation of state associations of gas, electric and street railway men. The territory embraced in the membership of the association includes Texas, Mexico, Louisiana, New Mexico and Arkansas.

Among the delegates who attended the Austin convention were the following: Ira H. Evans, Frank E. Scovill, George A. Hill, of Austin; Sam A. Hobson, Waco; H. A. Stucky, C. R. Watts, Austin; Charles F. Yeager, Laredo, Texas; T. H. B. Whipple, Cleveland, Texas; B. F. Bonner, Houston; J. R. Cox, Galveston; Thomas D. Miller, Dallas; J. R. Cullinan, Denison; J. C. Ward, Beaumont; A. P. Moore, Waco; E. W. Kaufman, New Orleans; Walter Jennings, Abilene, Texas; J. L. Sole, Dallas, Texas; W. S. Rothell, T. H. Stuart, Waco, Texas; L. J. Palfrey, T. L. M. Wortham, Houston, Texas; J. F. Strickland, Waxahachie, Texas; T. F. Harwood, Gonzales, Texas; A. E. Judge, Tyler, Texas; Fred Fries, San Antonio, Texas; A. E. Rathbone, Victoria, Texas; G. J. Wille, Marlin, Texas; C. W. Hobson, Waco, Texas.

At the opening of the meeting President Drake made a few remarks, welcoming the delegates to Austin, and expressed the hope that the growth and benefits of the organization should continue. Mayor John D. McCall was then introduced and made the formal welcoming address. Mr. T. D. Miller, of Dallas, Texas, responded to the mayor on behalf of the association.

The afternoon of the first day was spent in a very enjoyable manner. The delegates visited the State Capitol in a body and paid their respects to Gov. Joseph D. Sayers and the Legislature, then in session. Gov. Sayers addressed the visitors briefly.

Several cars were placed at the disposal of the visitors by the Austin Rapid Transit Company and a ride to Hyde Park and other places about the city was taken. At night an enjoyable reception was tendered the city's guests by Mr. and Mrs. Carl F. Drake at their home in Austin.

There was an increased attendance at the second day's business session, which was devoted to the reading of officers' reports. President Carl F. Drake, in presenting his report, said that those interested in the ownership and operation of gas, electric and street railway plants in the State of Texas, some years ago realized the necessity of a concert of action. In its inception the Gas and Electric Association conceived that their interests were in a measure identical. The street railway people not having been invited into the fold, and realizing the necessity of organized action, formed the Texas Street Railway Association. Owing to the large investment necessary to carry on the business of any one of these branches, the number of firms interested within the border lines of the State were necessarily small, and many of the best educators among the manufacturers and represetatives of the great supply concerns were obliged to attend two meetings, both of which were limited in their scope and membership, but held for the same general interest. It was, therefore, conceived that a combination of two associations would be a wise move. Upon investigation it was found that the sister republic of Mexico and the States and Territories surrounding Texas were entirely without organization of this nature. It therefore seemed that great benefits might be derived from the organization of an association whose interests were so thoroughly identical and whose territory embraced the southwestern portions of North America. To this end a committee appointed at Laredo organized the present association.

Mr. Drake referred to the fact that the organizations that were the parents of the present association were created, and very properly so, for a purely educational purpose. Their oganizers did not at that time conceive the limits to which they were likely to grow, and with them he heartily concurs and believes that the chief aim of this association should be the distribution of knowledge among its members, the relating of experience, the securing of information, and the suffusion of knowledge. There is also another field of interest embracing economy in construction, economy in maintenance, economy in operation, and under the latter head a thousand questions arise in every business man's daily experience.

After the secretary, Mr. E. L. Wells, had presented his annual report, Mr. T. D. Miller, of Dallas, read a paper on the subject of "The Science and Art of Selling Gas." After a brief discussion of Mr. Miller's paper, the convention then adjourned, and the afternoon of the second day was spent at Lake MacDonald, where the visitors were tendered a fish-fry by the people of Austin. In the evening they were tendered a reception and musicale at the Driskill.

There was a considerable amount of business transacted at the third day's session of the convention. The various committees made their reports, showing that the association is in good condition. The following officers were elected for the ensuing year: President, T. D. Miller, of Dallas; first vice-president, J. F. Strickland, of Waxahachie, Texas; second vice-president, C. A. Yeager, of Laredo, Texas; third vice-president, W. E. Hamilton, of Shreveport, La.; secretary, T. H. Stuart, of Waco; treasurer, Fred Freis, of San Antonio, Texas; board of directors, C. F. Drake, F. E. Scovill, of Austin; E. Dysterud, of Monterey, Mexico; Fred Freis, of San Antonio, Texas; E. L. Wells, of Marshall, Texas; J. C. Cullinane, of Denison, Texas. Waco was selected as the next place for holding the annual convention of the association.

The following papers were read and disposed of without much discussion: "A Model Plant Under Management," by J. F. Strickland; "Attractions for Street Railways," by T. H. Stuart; "Transformers," by Harry L. Monroe; "Means of Encouraging Diversified Use of Electric Current," by C. L. Wakefield.

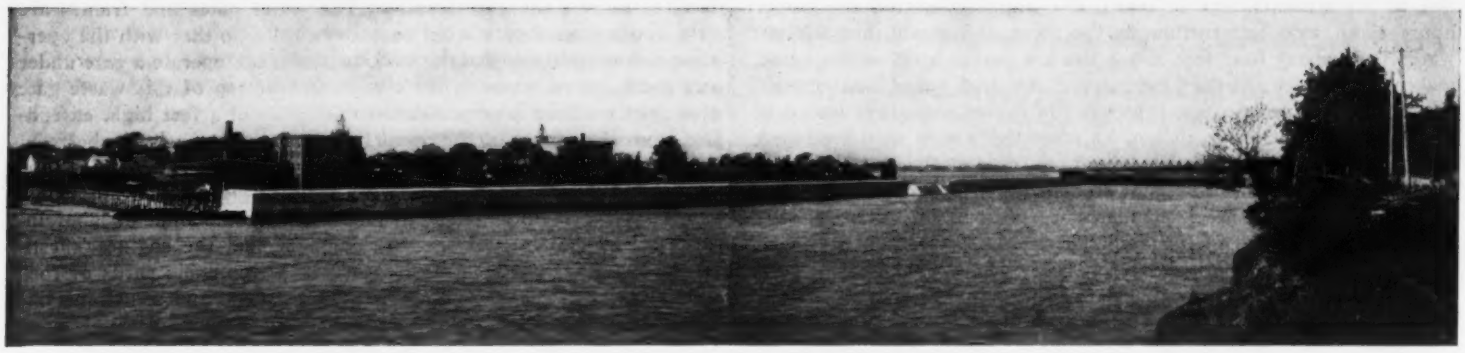
On the evening of the 19th the visitors were entertained with a Mexican supper at Hyde Park. There was on exhibition at the Driskill Hotel during the sessions of the convention a beautiful silver plate, appropriately engraved, which the association had purchased as a testimonial of their esteem for President Porfirio Diaz, of Mexico. The handsome gift was sent to Mexico's chief executive immediately after the sine die adjournment of the convention.

The paper by Mr. Strickland described a plant in a city of 8000 to 10,000 inhabitants, employing the 220-volt system. There are two 100-hp engines, each direct coupled to a 65-kw 220-volt direct-current generator. One generator is run continuously and the other thrown in parallel with it during the peak of the load. As business increases, it is intended to use the two generators or a 440-volt three-wire system, and install a 300-hp Corliss compound engine direct-connected to a 200-kw generator, which will deliver current at 220 and 440 volts. The generator leads are carried to the switchboard in vitrified conduit. The business of the plant is largely on a meter basis, and two-rate metering is being introduced as rapidly as possible.

In the paper by Mr. Stuart the subject of attractions for extending street railway traffic was discussed. In the case of a park on the line of the road, he recommends such amusements as baseball, picnic parties, bicycle races, balloon ascensions, fire works, trapese performances. All can be made good drawing cards. But if the entertainment must be confined to an auditorium, it must take the form of theatrical performances, musicals, balls, etc. But in any event, it is of the first importance that the opening attraction be well attended and a success. It is a singular fact that people like to go wherever the crowd goes, and if the season can be opened with a large crowd in attendance the battle is already more than half won. To this end great care should be exercised in selecting a first-class attraction for the opening and getting it properly advertised. Mr. Strickland suggested establishing an amusement circuit, embracing a number of cities. Before the opening of the season there would be employed for the entire season a high-class entertainment company for each city in the circuit, these companies to play alternately for a week or longer in each city of the circuit, the object being to furnish as often as necessary in each place new faces and new attractions, and at the same time relieve the management of a great deal of worry and annoyance.

The paper by Mr. Harry L. Monroe on transformers advised the necessity of test by the purchaser, and that the prices of the different kinds of transformers be not compared until after a comparison of the transformers themselves with regard to insulation, temperature rise, core loss, ageing and regulation. The standards that should be attained in these various respects were summarily discussed by Mr. Monroe.

The paper by Mr. Wakefield recommended that to encourage the diversified use of the electric current the resources of towns containing an electric plant should be thoroughly advertised in order to attract to them industries that would use light and power. Owing to high freight rates in Texas, he believed many classes of goods could there be locally manufactured.



The Water Power Development at Chambly.

BY CHARLES W. HAAS.

At the present time when the development of desirable water powers and the electrical transmission and utilization of the energy thereby obtained is attracting such widespread consideration from both capitalists and manufacturers, the attention of the reader is directed to the original features and subsequent improvement of the power site at Chambly, P. Q., some eighteen miles from Montreal, on the Richelieu River. This stream, as is generally known, is the outlet of Lake Champlain. It has a strong current, and before the building of the big dam at Chambly its course near that point was broken up by a series of rapids. It was to the possibilities of development which were offered at this place that the attention of the Royal Electric Company of Montreal was directed early in 1893, when the rapid increase in their business made it apparent that more power would soon be demanded, and that unless other arrangements were made, an addition to their steam plant would be necessitated. After due consideration, therefore, they secured an option on this water power at Chambly, extending from Chambly Basin for about four miles up the river, and had preliminary plans and estimates made. These first plans contemplated developing 15,000-hp by building two dams and two power houses, each for 12-feet head, at a cost, exclusive of the electrical machinery, of about $80 per hp. Vertical turbine wheels and gears and timber crib dams were proposed.

In the spring of 1894 A. C. Rice, of Dayton, Ohio, a hydraulic engineer of wide experience, was requested to examine the proposed water power and to prepare plans and estimates for its development. He observed that the question of anchor ice (frazil) was one that demanded serious consideration in designing a plant, where, as in this case, the development of uninterrupted power was contemplated. This was the more apparent because considerable trouble from this source had been experienced by the cotton mills on the Chambly side of the river, where water power to a limited extent had been utilized for some time. The records showed that the water in the Chambly Basin had been known to rise nearly 8 feet by reason of the accumulation of anchor ice flowing down the river. Engineer Rice concluded, however, that if the power house were properly located, and the power were developed under one head of 28 feet, there would be no anchor ice to interfere with the operation of the plant; and he prepared his plans accordingly.

These plans called for one power house and one dam, the latter built of concrete; and by the use of horizontal wheels and direct connected generators, it was proposed to develop under the head of 28 feet before mentioned, a total of 20,000-hp, or 5000-hp more than the plans of 1893, at a cost of about $28 per hp, exclusive of the electrical machinery. In order to satisfy themselves fully regarding the most practical plan to adopt, still a third engineer was called in, that his views of the feasibility of developing the power under one head of 28 feet might be obtained. The preparation of his plans and estimates consumed nearly a year's time, and, when submitted, were found to fully endorse the idea of one dam and one power house, though they called for a timber crib dam filled with stone. It was estimated, however, that the cost of the timber crib dam therein suggested, would have been some $40,000 more than the concrete dam called for in the plans of Engineer Rice.

In the meantime the Chambly Manufacturing Company had been organized, the principal stockholders in it being the men who composed the Royal Electric Company. They took over the water power options which had been secured by the Royal Electric Company, and proceeded to carry out the projects of their predecessors. The plans of A. C. Rice were adopted, and in August, 1896, a contract was entered into with the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, whereby they were to take the river and conditions just as they were at that time, develop the power demanded, and turn the whole plant over to the Chambly Manufacturing Company ready to run, except they were not to furnish the electrical machinery required.

Oct. 1, 1896, work was begun on the cofferdams, and during that winter some 10,000 cubic yards of rock were excavated under the power house and in the tail race. The concrete work on the dam and power house was commenced May 1 of the following year; and on Oct. 28, 1897, upon the completion of this portion of the work, the waste gates were closed, and the water began flowing over the crest of the big dam, the length of which, including the waste gate walls, is nearly 1900 feet. Unfortunately at the time the water began flowing over the dam, some of the concrete was only two weeks old, and owing to the very low temperature of the water it set very slowly; so that when the ice, some two feet in thickness, went out of the pond in the spring, it did some damage to the apron of the dam, repairs to which were made after the low water in the fall of 1898.

Having in mind the highest recorded rise in the Chambly Basin

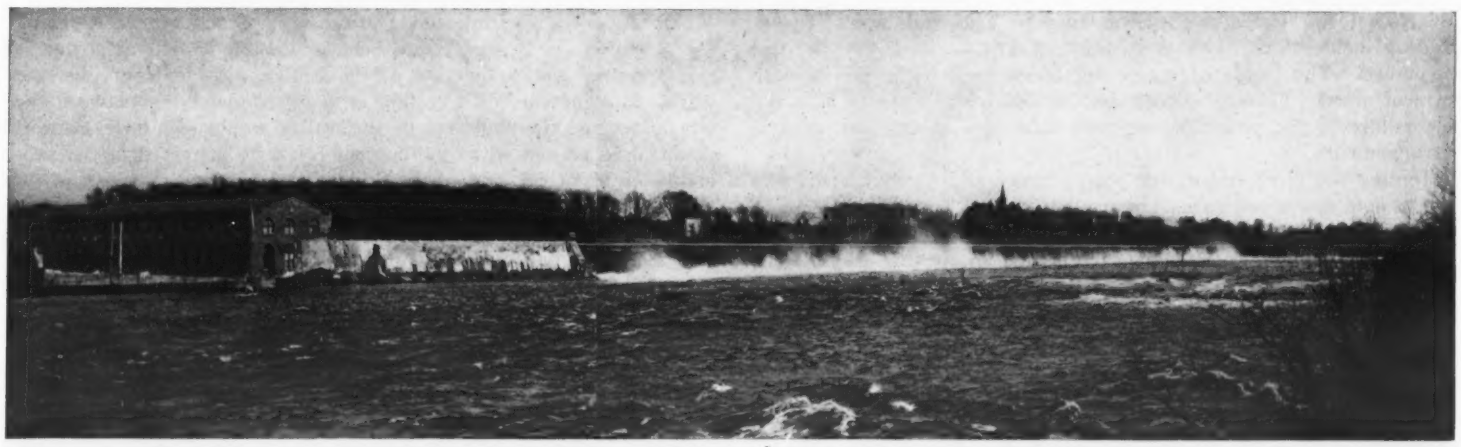


FIG. 1.—GENERAL VIEW OF THE CHAMBLY, CANADA, WATER POWER PLANT.

due to the accumulation of frazil, the engineer located the power house about 2000 feet further up the river, and established the tail water level about four feet above the low water level in the basin, making the wheel pits deep enough and the draft tubes long enough, so that if, as he anticipated, it was demonstrated that there would be no further trouble from anchor ice after the power was developed, the tail race could be excavated four feet deeper, thereby increasing the power about 2800-hp without any change in the machinery.

The forebay and wheel chambers are built in ten sections, with walls 5 feet thick between the chambers. The wheel pits are built in seventeen sections, with walls 2 feet 6 inches thick to carry the generator floor and power house, and bringing one wall directly under the centre of each generator. Through the arches and over the wheel chambers there are manholes 6 feet in diameter directly over the centres of the wheels, so that any part of the wheels can be removed from the outside of the generator room. The forebay, wheel pit walls and power house foundations are built of concrete; while the power house above the abutment and gallery floors is a steel face, to receive the gate frames. The waste gates and frames are cast iron and each gate is set on sixteen rolls, so that with the operating device on the top of the wall, two men can operate a gate under any condition of water in the river. On the top of this waste gate abutment wall is a pipe protection railing about 4 feet high, extending from the corner of the power house to the end of the abutment at the crest of the dam.

The specifications were carefully drawn up, and called for a high quality of work throughout. Some idea of the amount of labor involved may be gained from the statement that the engineer's estimates included, among other items, over 91,000 cubic yards of rock excavation, 33,763 cubic yards of concrete work, and something like 36 tons of half-inch round iron, this last named material being built into the dam. All of the electrical work and machinery was furnished and installed by the Royal Electric Company of Montreal. The heavy machine work was done in their shops at Montreal, the lighter work and assembling being done at the power house at Richelieu. This made the progress of this portion of the work very

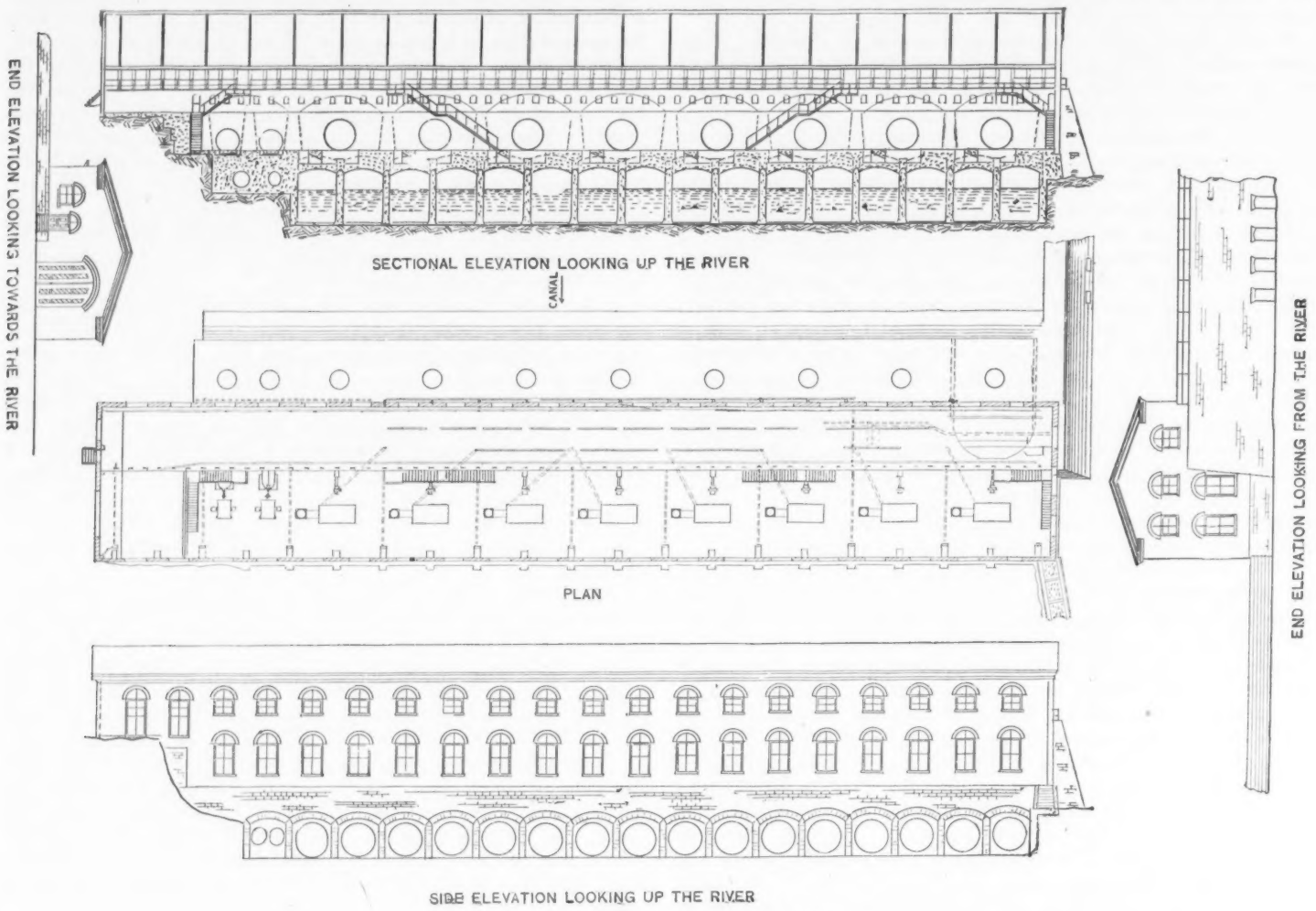

END ELEVATION LOOKING TOWARDS THE RIVER
SECTIONAL ELEVATION LOOKING UP THE RIVER
CANAL
PLAN
END ELEVATION LOOKING FROM THE RIVER
SIDE ELEVATION LOOKING UP THE RIVER

FIG. 2.—PLAN AND ELEVATION OF POWER HOUSE.

and brick structure 75 feet wide, 308 feet long and 30 feet high from the floor to the chord of the roof trusses. The walls are 13 inches and 17 inches thick, with one course of brick outside of the steel structure. The inside of the power house walls is plastered with cement mortar, finished smooth and painted. Fig. 2 shows plan and elevations of the power house, and illustrates clearly the general arrangements.

Joining the river end of the power house and forebay walls is a waste gate abutment wall. This wall is 27 feet wide on the base, 8 feet wide at the top, and is about 33 feet high and 185 feet long. It is provided with 15 waste gates, each having an opening 4 by 6 feet.

The dam is 26 feet wide on the base, 6 feet wide at the crest, and is 18 feet high above the apron; while the total height varies from 20 to 28 feet, with the crest 4 feet below the abutment. The overflow dam extends up the river 1151 feet, thence across the river 550 feet, where it joins the abutment on the Chambly side. This abutment has three feeder pipes 6 feet in diameter, for supplying the cotton, woolen and grist mills of A. T. Willet & Son with power. On the rear side of the waste gate wall, around the gate openings, is a continuous southern pine timber frame, built into the wall flush with the slow and expensive; but as the power was to be used in the city of Montreal, and the wire line had to cross the St. Lawrence River on the new Victoria Bridge, it has been impossible to deliver power in the city until the completion of the bridge. Aside from this, the disrupted ownership of a certain strip of ground lying between the city limits and the abutment of the bridge would still have made it doubtful as to just when the current could be delivered at the substation in Montreal, even if the bridge were finished.

The exciter wheels were first started Nov. 18, 1897, and the first power from them was delivered to a saw and grist mill at Richelieu, situated about one mile from the power house, Jan. 27, 1898. The generator wheels were started Feb. 22, and the first generator was connected to the wheels May 26, 1898.

The wisdom of developing the power under one head of 28 feet, with the idea of obviating the trouble previously experienced with frazil, was fully demonstrated during the winters of 1897-98 and 1898-99, when the cotton mills ran continuously without any trouble whatever; while at the same time the exciter wheels were operating, and the waste gates were discharging more water than the large wheels will ever use.

Twelve inches of the outside face of all the walls and the dam itself, is built of concrete composed of one part best Portland cement, two parts good clean sharp sand, and five parts of broken stone that would screen two inches, while the inside portion of the dam is built of large blocks of stone excavated from the tail race and filled solid with concrete.

for operating the wheel gates. Fig. 3 shows sectional elevation through the wheels and power house.

The 27-inch wheels, each of which develops 200-hp and 260 revolutions per minute under 28-foot working head, are used to drive the exciting generators. Each of these exciting generators requires 175-hp, leaving 25-hp in each wheel for regulation, which is provided by

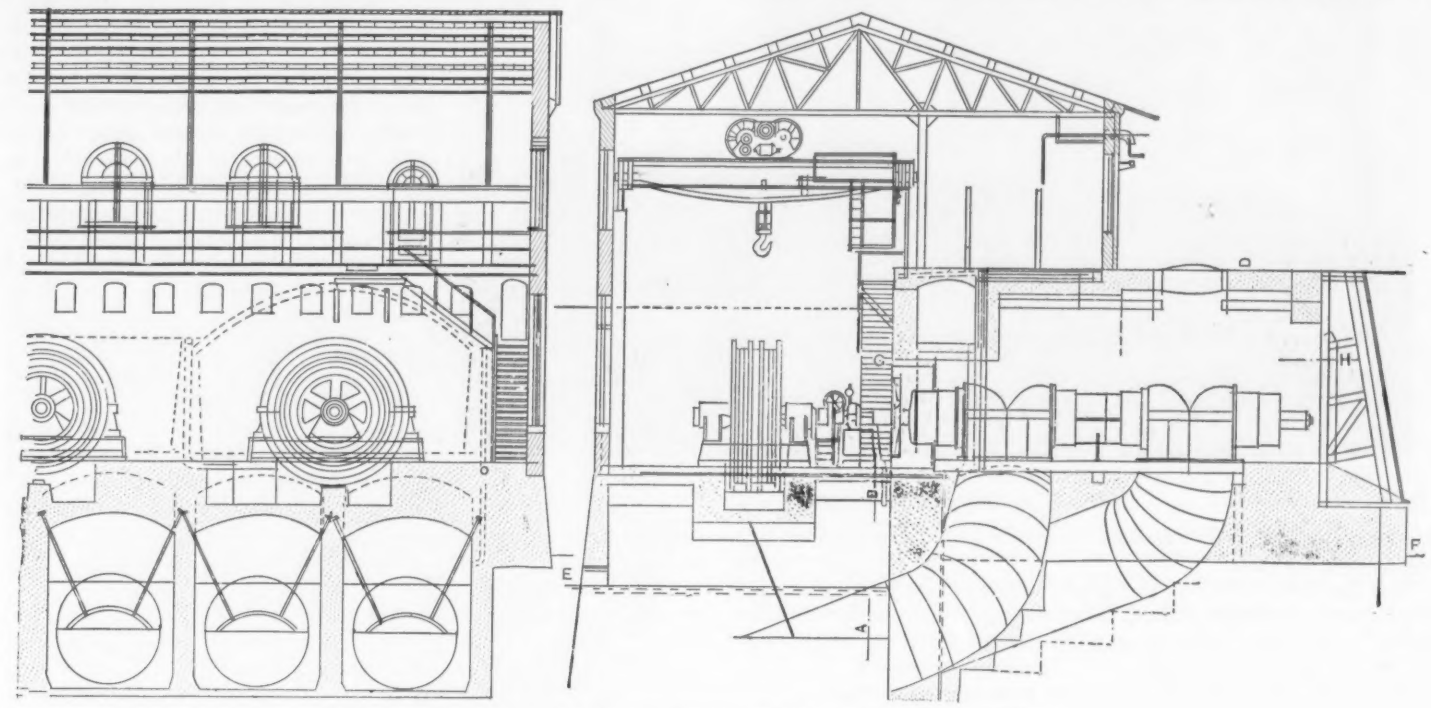


FIG. 3.—SECTIONAL ELEVATIONS THROUGH WHEELS AND POWER HOUSE.

The full turbine equipment will consist of 16 pairs of 46-inch cylinder gate horizontal wheels, and two single 27-inch cylinder gate horizontal wheels; all of the "Victor"type. The 48-inch wheels are used for driving the generators, each two pairs of turbines constituting one unit which will develop 2648-hp and 153 revolutions per minute under 28-foot working head. Each unit furnishes the motive power for one of the 2500-hp generators, leaving in the wheels 148-hp for regulation. For each two pairs of these wheels there is provided a Giesler electrical governor mounted in front of the wheel chamber, with a suitable hand wheel located near the governor and generator

a Snow mechanical governor for each, mounted in front of the wheel chamber. Sectional elevations through the exciter wheels and power house are shown in Fig 4. At the present time both the exciter wheels are in place, and eight pairs of the generator wheels. The

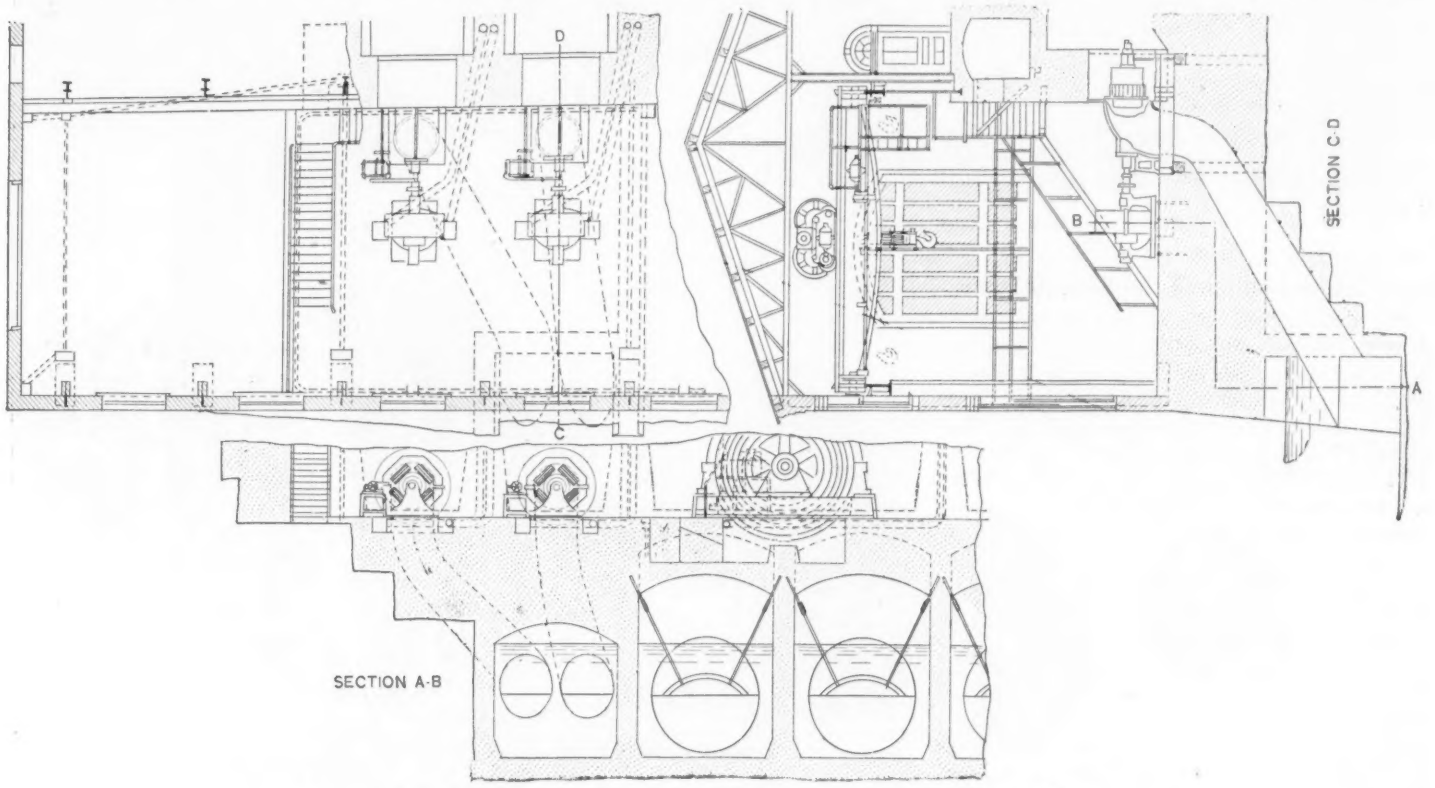


FIG. 4.—SECTIONAL ELEVATIONS THROUGH EXCITER WHEELS AND POWER HOUSE.

power house, forebay and wheel chambers are, of course, arranged for the reception of the remaining eight pairs of generator wheels as soon as the Chambly Manufacturing Company may call for them.

Fig. 5 shows the exterior, and Fig. 6 the interior of the power house. It will be observed that it is light and roomy; the gen-

erators on one floor and the switchboards in the gallery above where the operator can have an unobstructed view of the whole generator room.

The entire plant affords an excellent example of modern engineering practice, and great credit is due both to the engineer and the builders of the powerful turbines and generators. Unusual interest has been manifested in the progress of the work by prominent

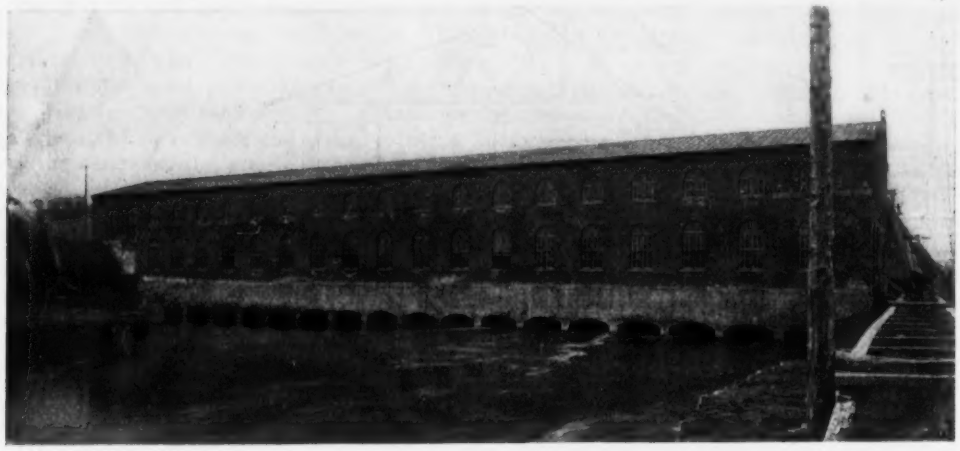


FIG. 5.—EXTERIOR OF POWER HOUSE.

engineers, and the plant has been visited by a number of the leading engineering societies.

The four sets of wheels and generators were started April 10 for a continuous trial run of thirty days, as provided for in the contract between the Chambly Manufacturing Company and the contractors for the water-power equipment. The results have been very satisfactory, indeed, and a rheostat test of the generators has shown as high at 3160-hp output of one generator with about a 30-foot head of water on the wheels. As soon as the wire line to Montreal can be completed, the abundant supply of electrical power available will prove of immense value to the industrial interests of the city, and will mark the beginning of an era of greatly improved conditions.

All the iron and steel work, including the waste gates, hand rail, rack frame and rack, wheels, draft tubes, steel structural work in building, traveling crane and crane track, was furnished by the Stilwell-Bierce & Smith-Vaile Co., who contracted, as before stated, for the entire hydraulic plant; but sublet the work of excavation and building to Peter Lyall & Sons of Montreal.

English Government Telephone Scheme.

The English government has brought forward a measure authorizing municipal authorities to borrow money for the purpose of establishing telephone exchanges, and the Post Office is also about to enter into competition with the National Telephone Company in the metropolis. A Treasury Minute has been issued setting forth on what terms the government proposes to grant telephone licenses to local authorities. To a certain extent the licenses will be on the same terms as that of the National Telephone Company, all being terminable on Dec. 31, 1911, and all rendering the licensee liable to pay a royalty to the Post Office of 10 per cent. on the receipts. Certain additional facilities are to be given to the municipalities, however, one of which is the permission to telephone messages over long-distance lines to post offices at the far end, for transmission as express letters, to any persons whether subscribers to telephone systems or not. This privilege was nominally accorded to subscribers of the National Telephone Company seven years ago, but only so far as local messages were concerned. As a matter of fact, however, very few post offices were equipped with telephone instruments, so that the regulation was practically useless. The local authorities are to establish their exchanges with such plant and material as meets with the approcal of the Postmaster General, their tariffs are to be subject to his censorship, and their accounts are to be submitted to him yearly.

At the end of the period of the license the Postmaster General undertakes to purchase as much as is useful to him of the telephone plant at its then value, this unknown quantity being determined by arbitration in the case of a dispute. It should also be mentioned that all lines are to be built on the metallic return principle, and that call offices are to be established in post offices and facilities given for connection to the long-distance lines (which are the property of the post office in England. In places where competition is started with it, the same undertaking with regard to purchase is given to the National Telephone Company so far as concerns the plant existing at the time competition is started. The post office will only consider the purchase of plants erected subsequently to that date if the National Telephone Company gives facilities for inter-communication with municipal exchanges in a manner approved by the Postmaster General. All these restrictions and regulations are certainly of a nature to impede telephonic progress in Great Britain still more than it has been impeded hitherto, and the opinion is fast gaining ground in that country that the only reasonable solution of the telephone question is for the government to buy up all the National Telephone Company's present undertaking, and to manage the telephone service itself as an independent department under the control of the Postmaster General.

It will be obvious to anyone who studies the plan or proposition that difficulties of the gravest nature attend it, largely from the fact that a great deal of the value of a telephone system lies in the ability to reach outlying towns and suburbs and to converse over long distances. None of these municipal exchanges can own or operate long distance lines, and even the intrinsic purchase value of their local plant is left a matter of doubt. It will be noticed that at the very outset exterior lines become a serious problem.

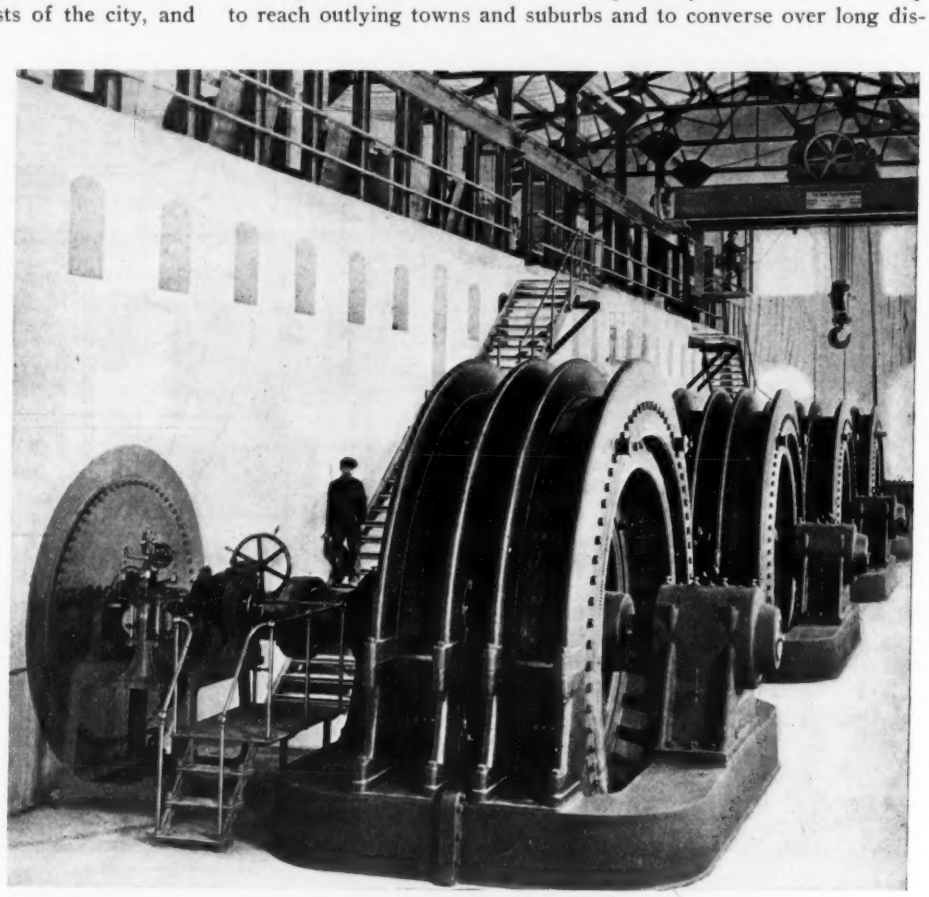


FIG. 6.—INTERIOR OF POWER HOUSE.

Electrical Radiation.—IV.

BY ARTHUR V. ABBOTT, C. E.

HAVING thus considered the general qualifications of transmitting and receiving apparatus, the practical operation of signaling through the ether may be investigated. A convenient form of oscillator, at least for experimental work, is shown in Fig. 6.

It consists of a six-inch coil mounted on a base supplied with a Morse key arranged to interrupt the primary of the coil, and three insulated standards: The centre one supporting the main sphere, while the outer ones are the terminii of the coil. The waves from such an oscillator may be easily detected within a range of a few

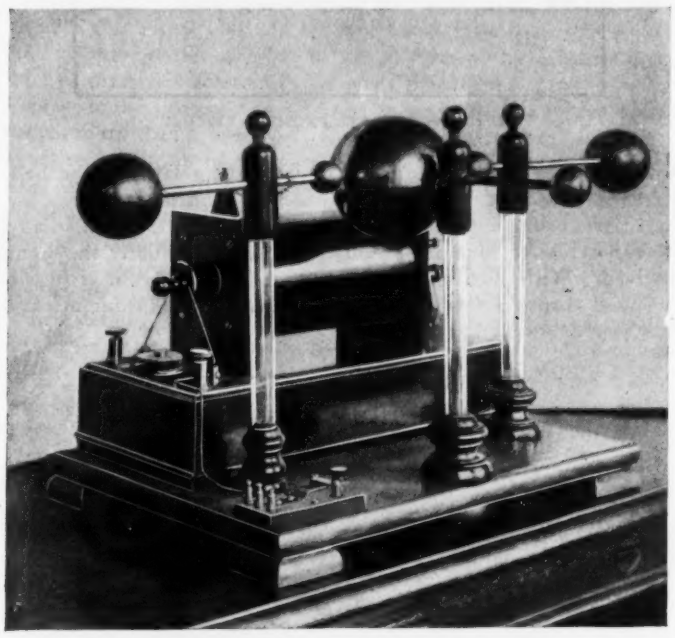


FIG. 6.—SPHERICAL OSCILLATOR.

thousand feet. For greater distances, experience has shown the desirability of grounding one of the terminals of the coil and connecting the other one to a sphere or plate elevated to a considerable distance in the air on a mast, or by means of a kite or balloon. As the plate forms an emission surface a sufficient elevation aids to carry the waves above the surrounding objects, which, by partial reflection, tend to their extinguishment, and thus the influence of the coil may be extended over a greater radius. The circuit of the transmitter is shown in Fig 7, which is self-explanatory.

Such an oscillator, by changing the size of the central sphere and

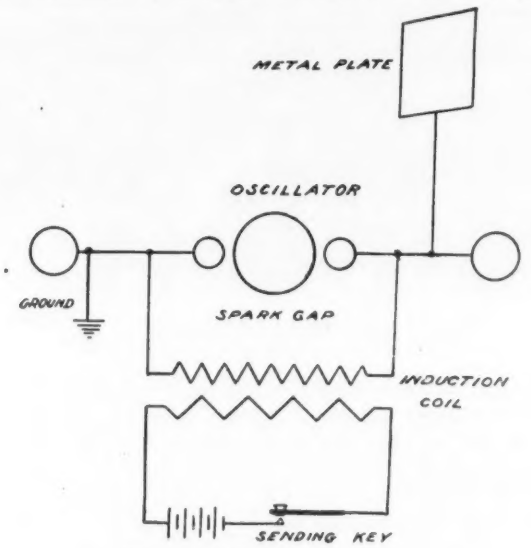


FIG. 7.—OSCILLATOR CIRCUIT.

varying the capacity of the terminii, may be made to emit almost any desired length of wave. Other forms are shown in Fig. 8. which is the type used by Hertz, consisting of a pair of long linear rods supplied with movable plates, the distance between which may be adjusted by sliding them to and fro upon the rods. Fig. 9 shows a set of spheres arranged in series, thus presenting a number of spark gaps, which tend to increase the intensity of the waves delivered. In Fig. 10, on the left, a single sphere is placed inside of a metallic cylinder. By this means the oscillator is made less dead-beat and a greater number of vibrations secured. In the

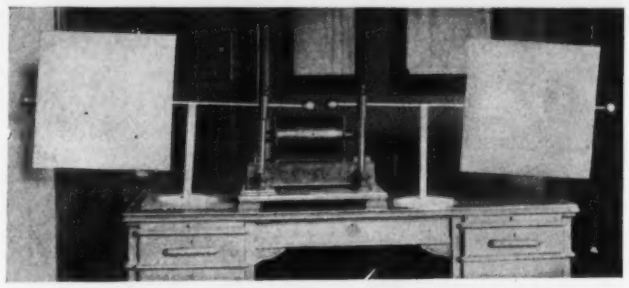


FIG. 8.—FORMS OF OSCILLATORS. HERTZ DESIGN.

same illustration, on the right, a pair of spark knobs are placed inside of a cylinder, the sparks occurring between the knobs and the inner surface.

The simplest form of detector or receiver is a coherer, small battery and vibrating coil, all arranged in series, as shown in Fig. 11, while the circuit is given in Fig. 12.

Connected in the manner indicated, the bell remains silent. If the terminals of the tube be short-circuited, for an instant, the clang of the bell at once proves that it is only the resistance of the filings that prevents it from sounding. A touch on the key of the coil causes the oscillator to spark and instantly the ringing of the bell shows that the coherer has responded to the radiation. As in this simplest form there is no provision for decoherence; it is necessary to give the tube a tap in order to break the welds and restore the instrument to its normal condition. The simplicity of this ap-

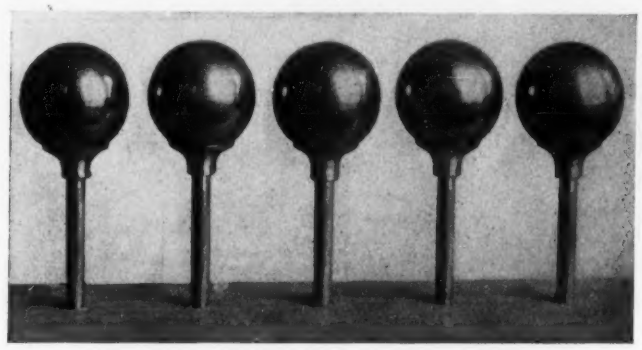


FIG. 9.—SERIES OF SPHERES.

paratus makes it attractive for experimental work, and it is sufficient to show all of the laboratory experiments in electric waves.

To prove the penetrating power of Hertzian waves, the coherer bell and battery may be placed in a wooden box provided with a tight-fitting cover, securely fastened. A touch on the coil key at once sets the bell sounding, showing that the wood of the box is practically transparent to this form of radiation. Now, if a tin can be substituted for the wooden box, the bell no longer responds, even to prolonged sparking. Maxwell showed mathematically that

FIG. 10.—ENCLOSED SPHERES AND CYLINDRICAL OSCILLATOR.

all insulators would be transparent, and all conductors opaque to electric radiation. If the cover of the iron box be opened the bell would be expected to respond, but trial shows that it will not. At first this result is surprising, until it is considered that the waves emitted by this oscillator are at least eight inches in length, and as the box is deep and narrow, the coherer is evidently in an elec-

trical shadow, but if a bit of wire connected to the coherer circuit be drawn out of the box, the bell immediately rings, for this wire serves as a collector, and conveys the radiation to the coherer.

For space telegraphy a more automatic apparatus is desirable, which may be arranged as shown in Fig. 13, while the circuit is

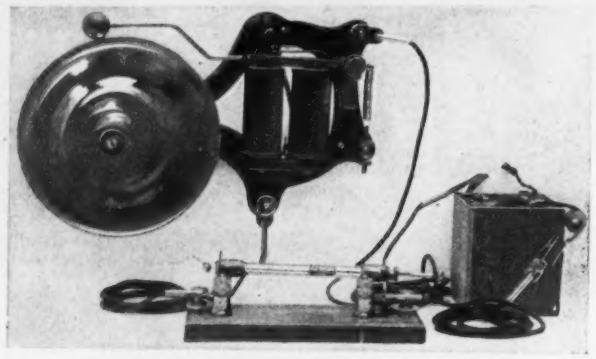


FIG. 11.—SIMPLEST RECEIVER.

given in Fig. 14.

The coherer tube is supplied with clock-work that keeps it constantly rotating at a speed of five or ten revolutions per second. In

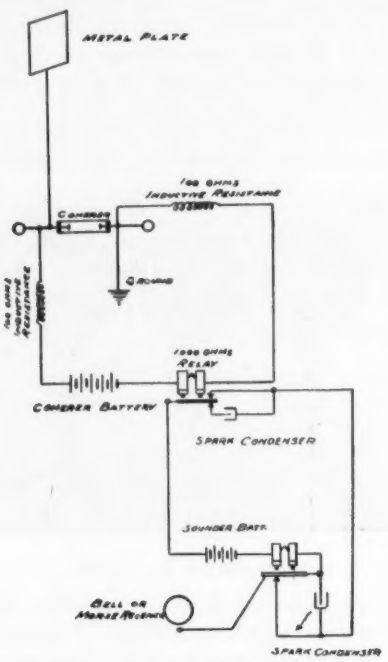


FIG. 12.—SIMPLEST RECEIVER CIRCUIT.

series with the coherer are four cells of dry battery and a sensitive relay of some 500 or 1000 ohms. One side of the coherer is grounded, while the other side is connected to an elevated plate upon a

FIG. 13.—COMPLETE RECEIVER.

kite or mast. Between the relay and battery connections to the terminals of the tube two impedance coils are placed that offer essentially no obstacle to the battery current but which aid to concentrate the electric pulses upon the filings and prevent the coherer from becoming short-circuited. The local of the relay is provided with a separate and independent battery and any form of indicating instrument, such as a bell, a Morse ticker, or recorder, or a Wheat-

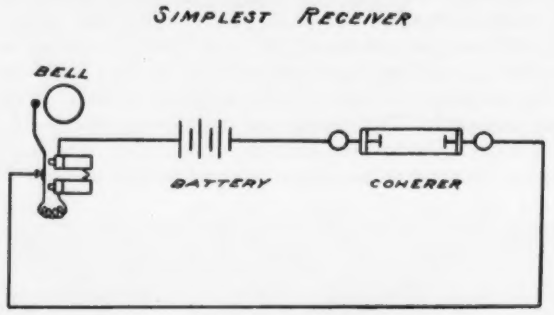


FIG. 14.—COMPLETE RECEIVER CIRCUIT.

stone dial. Around the contacts of both the relay and the bell a condenser of about two M. F. is placed to absorb the sparks from these parts of the apparatus, otherwise a local spark would so affect the coherer as to blur and confuse into unintelligibility the signals received. With such apparatus, crude though it be, it is possible to signal through some miles of space and to transmit messages clearly and intelligibly.

Electrical Notes From Japan—III.

BY PROFESSOR F. B. CROCKER.

IN most places the charges for electric lighting in Japan are about the same as in the United States, while the cost of labor and administration are considerably less, firemen and dynamo tenders receiving about 25 cents (U. S. equivalent) per day; this is more or less balanced by the fact that coal is generally more expensive, the price having risen—in fact, doubled—during the last few years. The original cost of the apparatus and the ordinary rate of interest are both higher than in America or Europe, consequently fixed charges are also considerably greater. As much as 8, 10 or even 12 per cent.

FIG. 8.—ELECTRIC LIGHT LINE IN OSAKA.

per annum are commonly paid for capital, 7 per cent. being allowed on fixed deposits by the Mitsui Ginko, a very prominent banking house. It will be seen that these rates are about twice as great as those prevailing in our country. The rapid development of Japan and the prohibition against investment by foreigners (in their own name) are the principal reasons for these high rates of interest. The opening up of the country under the treaties which go into effect on July 1, 1899, will probably result in reducing the average interest charges, since foreign enterprise will then be allowed to penetrate to all parts of the country, whereas before that date it has been confined to small "concessions" (limited areas of a few acres) in certain "open ports." I do not pretend to discuss the general wisdom of the new treaties, since they involve many far-reaching questions of great complication, and are strongly condemned by

many persons who have had long experience in Japan. It remains to be seen how they will operate, especially in regard to placing all foreigners wholly in the power of the Japanese courts. Formerly their legal affairs, both civil and criminal, were administered by consular courts exercising extra-territorial jurisdiction for their respective governments. Difficulties will naturally arise at first, but it is to be hoped that they will soon be overcome.

In referring to fixed charges, I made the statement that they "are considerably greater." Perhaps it would have been more correct to have said that they should be greater. Unfortunately it is a common mistake in Japan to allow too little for this item, and also fail to charge off a sufficient amount each year for depreciation in machinery, etc. In some cases the total original cost of the plant is carried on the books as an asset for years without alteration, although the actual value of the apparatus may have fallen to one-half or one-quarter of what it was at first. I have heard that the cost of repairs is sometimes added to the original price in order to represent the present value. On the same basis a patched coat is worth more than a new one! But juggling with ledgers is not confined to Japan; in many other countries wear and tear are ignored and repairs are called "betterments." Very often the error is due to short-sightedness or lack of experience and injures the inside parties far more than anyone else. This is probably the case with the Japanese, who have not been using machinery long enough to realize how rapidly it depreciates or becomes obsolete.

In a temple on Mount Hici near Kyoto, I was shown an object lesson most impressive to the electric light engineer. It was a lamp

FIG. 9.—ARC LIGHTS ON BRIDGE AT KYOTO.

FIG. 10.—ENTRANCE TO CANAL AT LAKE BIWA.

that had been kept burning for eleven hundred years! How many interesting trains of thought are suggested by it. For reliability of service it merits our highest praise—the most complaining of customers would be satisfied. But if we consider the amount of his bill, it would be a different matter. At one cent per lamp hour, he would have to pay $96,360, and if interest—in fact, compound interest—were charged, the account would run up into millions. The central station men would point out the moral that bills should be settled promptly, but the customers might say that lighting is an expensive luxury. Allowing only 5 per cent. depreciation per annum, the plant should have been entirely renewed fifty-five times. This is a pleasant thought for the manufacturer of apparatus and the consulting engineer, but the lamp maker with his guarantee of a paltry 1000 hours burning should hang his head in shame. I confess to a feeling of awe, while gazing at this perennial light, and the impression was still strong the following day when I asked a Japanese friend about it. He cast some doubt upon the matter, but as it is a historical fact that temples have existed at this particular place for much more than 1100 years, anyone including the reader, is privileged to believe the legend or not, as he pleases.

Some idea of the familiar appearance of electric things in Japan and the incongruity of their surroundings may be obtained from Fig. 8, which shows an electric light pole with transformer attached in an Osaka street that is thoroughly characteristic of the country. Fig. 9 is a view showing an arc lamp and electric light lines on a bridge at Kyoto. It is interesting to note the platforms beneath the bridge upon which many of the inhabitants spend their nights as well as days in order to keep as cool as possible during the hot weather. This is a popular and established institution of Kyoto, the ancient capital of Japan. Electric power in Japan is not so far advanced as the other three applications of electricity already described. As pointed out in my first letter, this accords perfectly with the introduction of electric power in other countries. In 1887 an electric motor was quite a curiosity in the United States as there were very few of them in use at that time, while the telegraph, telephone and electric light were almost as familiar to the public as at present. The introduction of electric motors in Europe has been a still slower process, especially in England and France, where the number in operation is an insignificant fraction of those in America. Hence it is to be expected that electric power should be somewhat backward in Japan also, but she has already made an excellent start in this direction and the prospects for its future development are almost unlimited as is the case in all the progressive countries of the globe. If we include long-distance transmission and local distribution of power, as well as electric railways under one head the possibilities—in fact probabilities—of growth are greater than of all other electrical applications combined. This statement applies to Japan and to all the rest of the world.

The most important power plant in that country at present is the hydraulic-electric system at Kyoto. It was constructed for the municipality at a cost of about one million dollars (U. S.), the expense being shared by the city, the nation and the emperor. One of the features of Japanese finances is the fact that a large part of the revenues from various sources is turned over to the emperor, in addition to the amounts ordinarily allowed to a monarch for the maintenance of his household. For example, the last payment from China and Japan for war indemnity was given outright to the emperor by the Imperial Parliament. In the press there was some opposition to this action, nevertheless the vote of the members was unanimous. The Mikado is looked upon as the father of his people, his interests being the same as theirs, and since he actually ranks as a god, directly descended from the Sun goddess, he must be infallible. While all this may not be implicity believed by everyone of his subjects, it is far more than a myth. The sacredness of his person, the paternal character of his authority and of his responsibility form the very foundations of the government. They are not only poetical ideas, they are actual facts.

This plant was shown to me by Mr. Kato, the engineer in charge, who was exceedingly kind in many ways. The system is especially interesting on account of the number of useful purposes which it serves. It consists of a canal about 10 miles long extending from Lake Biwa to the outskirts of the City of Kyoto. The lake is the largest in Japan, having an area of 44 square miles, and with the rivers flowing into it forms a considerable basin nearly in the centre of Nippon, the main island. A considerable freight and passenger trade is carried on up and down this canal by means of boats that are comparatively small because the canal is only fifteen or twenty feet wide in most places. The quantity of water delivered by the canal is sufficient to develop about 2000-hp, where part of it is delivered near the city. Another portion is carried in a canal to the Imperial Palace and the remainder to the large Hongwanyi Temples mainly for use in putting out fires, which are very likely to occur in such buildings as they are constructed almost entirely of

wood. Water is also tapped off from the canal at many points for irrigation of rice fields, etc. Strange to say very little of the water is used for drinking purposes, but it is intended to do this in the near future. Almost one-half of the main canal consists of tunnels through the intervening mountains.

The design and construction of this important work are of a high order and it is a great credit as well as benefit to the city. The very picturesque scenery and buildings near the entrance to the canal at Lake Biwa are inadequately represented in Fig. 10.

It will interest my professorial friends and their students to know that the original plans for this important system formed a graduation thesis in engineering at the Imperial University, the author being made chief engineer of the work. The electrical generating plant contains about 12 Pelton wheels which drive by means of belts, 550-volt direct-current dynamos as well as single-phase and two-phase alternators aggregating 2000-hp. The current is carried all over the city to supply arc and incandescent lamps, stationary electric motors as well as the electric railway which is one of the few in Japan at present and will be spoken of under that head. The number of stationary motors in operation is considerable and forms a large part of the business. They together with the electric railway keep the "day load" up to a point much greater than in most central stations. The awkward lapping over of the motor and lighting loads between 4 or 5 and 6 o'clock during the winter is avoided by merely cutting off the motor circuits and switching on the lighting circuits when it grows dark. This simple but rather arbitrary procedure would hardly be acceptable in America, but the fact that it reduces the rates is a strong argument in its favor. Moreover it is a common practice in Japan to stop work at dark either from long custom or because illumination would be too expensive.

This unique hydraulic-electric system utilized for navigation; irrigation; drinking, washing, etc.; fountains, lighting, power, railway and many other purposes was shown and explained to me by the chief engineer, Mr. Kato, who was exceedingly courteous. He also spent considerable time in showing me motors used for rice polishing and other purposes characteristic of the country. The very large Murai cigarette factory producing 7,000,000 cigarettes a day, is operated by a 95-hp Siemens induction motor.

The rates charged for power are very low, being only $32 (U. S.) per horse-power per annum for 1-hp or more, and only $16.50 per horse-power for amounts over 100-hp. These figures were established several years ago by contract when the price of coal was less than half of what it is at present. They could very reasonably be advanced and probably will be when existing contracts expire. The gross income from all sources is $60,000 (U. S.), so that when expenses are deducted, the return is only about 3 per cent. on the capital invested. But since it is a public matter which benefits the city in many ways, it certainly may be considered to be a great success even from the financial point of view, and technically it seems to operate exceedingly well.

I visited a rice polishing establishment using a 1½-hp motor to take the place of about 16 men working 10 hours per day. These men would receive about twenty cents (U. S.) per day each or $3.20 for all. This would amount to $960 per year for 300 working days, whereas the electric power only costs 1½x32 or $48, which is exactly one-twentieth as much. This shows that electric power competes very favorably with manual power (or rather pedal since they work with a sort of tread mill), even where labor is exceedingly cheap.

FIG. 11.—ELECTRIC RAILWAY CAR AT KYOTO.

FIG. 12.—TRACK CURVE AT KYOTO.

Telephone Relays or Repeaters.

By William J. Hammer.

IT is now almost twenty-three years since the memorable Sunday afternoon, on which Prof. Bell exhibited his speaking telephone before a select coterie, including Lord Kelvin and Dom Pedro, Emperor of Brazil, at the Centennial Exposition in Philadelphia, in 1876. Since that date a large amount of time, thought labor and capital have been expended in endeavoring to make a practicable telephonic relay or telephone repeater. I believe that with one exception, nothing that can be considered of a commercial character, has been presented to the public. The exception was the apparatus used by me in connection with the long distance sound transmission experiments, shown in connection with a lecture which I gave on "Edison and His Inventions," before the Franklin Institute in Philadelphia, on Feb. 4, 1889. At that time, and subsequently, I issued a number of blue prints, illustrating diagrammatically, the apparatus employed, certain of the experiments performed, and giving an analysis of the scientific phenomena connected therewith. Although this was ten years ago, practically no development in this direction has resulted from these experiments, although they indicated a most promising field for investigation and invention.

I have recently had occasion to prepare a new drawing in which is given more fully, an analysis of the scientific phenomena connected with the experiments referred to, and which includes additional details of the long distance telephone circuits, and the various apparatus employed. I take pleasure in reproducing this drawing at this time, believing that it will prove of interest not only to telephone men, but to the electrical profession generally, and perhaps stimulate investigation in this direction.

At the time of my lecture before the Franklin Institute on Feb. 4, 1889, I stated that by employing more telephones and phonographs, the sound could be recorded and reproduced a great many times, thus enabling the transmission of sound over a great many circuits, and over very long distances. I stated that theoretically, it was possible for a man to whisper in his own ear around the circumference of the globe, by employing Edison's loud-speaking telephone and Edison's phonograph as a telephonic relay; and I also made the statement that I believed it to be fully possible, as a result of my investigations, to telephone from New York to San Francisco, by employing the form of telephonic relay which I had devised. I also made the statement, that it was possible to duplex by means of the apparatus which I employed, and referred to some experiments which I had made in this direction.

I stated by way of illustration, that it would be possible for a Frenchman in Paris to transmit by means of the phonograph, the soul-stirring strains of the "Marseillaise," over a telephone wire to Berlin, at the same time during which a German in Berlin, would be transmitting the sublime melodies of "Die Wacht am Rhein" by

means of a phonograph over the same telephone line in the opposite direction, to the City of Paris. When they were through, in addition to his own music, each would have the other's piece of music upon his phonograph cylinder, thus producing an interchange of international courtesies, which had probably never been thought of before.

I might mention incidentally, that connected with each Edison electro-motograph receiver, was a carbon transmitter. There was also a Bell receiver, connected with the transmitters at both the New York and Philadelphia ends of the line, enabling the operators to converse with each other at these points. In addition, telephone transmitters were placed upon the stage, which enabled audiences in fourteen cities to listen to the lecture, and the instrumental and vocal music and talking transmitted from New York, was retransmitted to the various gatherings, from the Franklin Institute stage.

Almost immediately after my lecture before the Franklin Institute, I went to the Paris Exhibition of 1889, as the representative of Mr. Thomas A. Edison and the various Edison interests. Shortly after my arrival, I was invited to reproduce the experiments which I had made in America, between Paris and Brussels, under certain governmental auspices. The arduous character of my work at the time precluded the possibility of my accepting this invitation. I did, however, later, repeat certain of these experiments with additions, under the auspices of the Electrical Section of the Jury of the Paris Exhibition. One end of the telephone circuit was in my private office in the Edison section in the Machinery Gallery, at the Exhibition, and the other end at the house of Mr. Louis Rau, a member of the Jury, and president of the French Edison Company. One of the interesting additions to my previous experiments, which I made on that occasion, was the singing of the "Marseilles" upon one-half of a phonograph cylinder placed in a parlor at Mr. Rau's house, the music being then transmitted by telephone to the top of the house, where it was recorded upon a second phonograph, and then instantly repeated back to the original phonogaph, which thus contained both records, which were reproduced very perfectly. At the time of this meeting, I stated the possibility of duplexing, and repeated the reference to the interchange of international courtesies already referred to, and I also repeated the statements which I had made at my Franklin Institute lecture, that the phonograph I believed, would ultimately be used as an adjunct to the telephone, in order to keep a record of conversations passing over the lines, and as a means by which one party who called up another in his business, could leave important messages upon the phonograph at the further end of the line, which phonograph could be automatically operated for such a purpose.

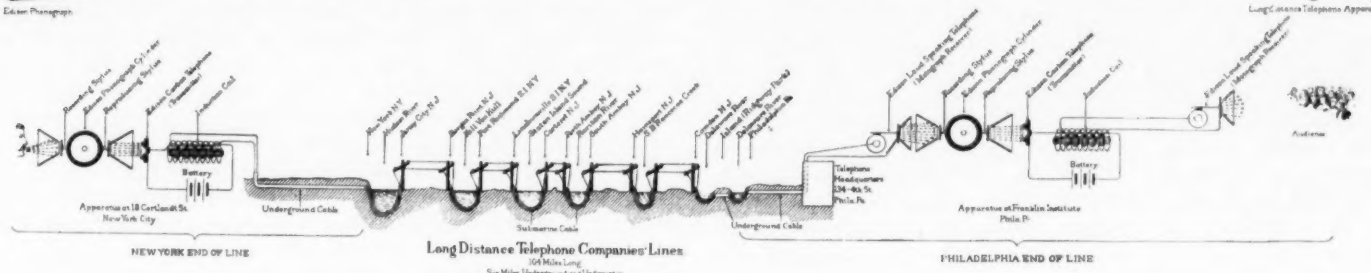


DIAGRAM OF CIRCUITS OF EXPERIMENTAL LONG-DISTANCE TELEPHONE-PHONOGRAPH LINE.

At the time of my lecture before the Franklin Institute, the ELECTRICAL WORLD of Feb. 16, 1889, published an editorial which I think should be quoted here as one indication of the importance attached to the results accomplished. The editorial is as follows: "Recording Telephonic Conversation.—There were probably few among the audience which listened to Mr. W. J. Hammer during his lecture on 'Edison and His Inventions,' before the Franklin Institute, and saw his experiments on the transmission and recording of speech between New York and Philadelphia, who realized that they were highly privileged. They had witnessed what is unquestionably the first practical example of the recording of speech transmitted telephonically over an actual line wire. There were embodied in the accomplishment of this experiment, three of Mr. Edison's greatest inventions, the phonograph, the carbon transmitter, and the motograph receiver, and with their combined employment what has long been sought for was accomplished, and, we may add, with complete success. To those who are acquainted with the great difficulties encountered in new experiments in the field of telephony, the smoothness and success of those just accomplished are little short of marvelous, and show all three instruments employed in them to be the product of true genius in the perfection of their working. The effect of this successful attempt can hardly be foretold! It opens up at once a wider field not only for the telephone, but for a greatly increased application of the phonograph, for after this demonstration, we need only imagine each telephone provided with a suitable phonograph, so that all conversation may be recorded if desired. Or, on the other hand, we may conceive a conversation recorded at the other end of the line during the absence of any one at the receiving end, and repeated by the phonograph upon the arrival of the person for whom the message is intended. Other applications will suggest themselves to our readers. As above stated, these experiments mark an epoch in the field of telephony and phonographic recording, and Mr. Hammer 'builded better than he knew,' well aware as he was of the meaning of the test he had in hand."

In this connection I would state that prior to my experiments, quite a number of experts stated that I was attempting an impossibility, one of them remarking that I had "bitten off more than I could chew."

In conclusion I would only add that I have always felt convinced as a result of my experiments in this direction, that it opened up a most promising field, and one which would ultimately lead to an extensive commercial application of the loud-speaking telephone and the phonograph to the telephonic transmission of sound.

The following is an analysis of the scientific phenomena connected with the experiments to which the accompanying illustration refers, which shows diagrammatically the various details of the telephone circuits and the apparatus employed:

There were employed two Edison phonographs, two Edison carbon transmitting telephones, two Edison motograph receivers or loud-speaking telephones, two sets of induction coils and batteries, and 104 miles of long-distance telephone circuit, six miles of which was underground and submarine cable, and 98 miles of which was wire strung on poles. In this experiment in which three of Mr. Edison's remarkable inventions were shown working in juxtaposition, it will be observed that the sounds, which consisted of talking, singing and cornet playing, were transmitted through the air five times, and were transmitted through no less than fifteen distinct mediums, from the speaker and musician in New York to the audience at the Franklin Institute in Philadelphia. These mediums included vocal chords, cornet, air, glass, iron and mica diaphragms, carbon buttons, styli of steel, palladium-faced pens or springs, hydrogen gas, distilled water, wax and chalk cylinders, copper wire and the mechanism of the ear.

The physical characteristics of the sound waves were changed during transmission, no less than 48 times, as follows: (1) Air waves produced by vibration of the vocal chords in the speaker's throat or by the cornet. (2) Vibration of the glass diaphragm of the phonograph recorder, producing variations in curvature of the diaphragm. (3) Variation in longitudinal stress of the steel stylus attached to glass recording diaphragm. (4) Undulations in the wax cylinder of the phonograph. (5) Variation in the longitudinal stress of the steel stylus attached to diaphragm of phonograph reproducer. (6) Vibration of the glass diaphragm of the phonograph reproducer causing variations in curvature of diaphragm. (7) Sound waves through the air. (8) Vibrations of the iron diaphragm of the carbon transmitter producing variations in curvature of the

diaphragm. (9) Varying pressures on the carbon button, varying the resistance of the carbon exactly in accordance with the number and amplitude of the vibrations of the diaphragm. (10) Pulsatory current produced in the primary winding of the induction coil. (11) Undulating magnetic force produced in the iron core of the coil. (12) Alternating electric currents in secondary winding of the coil. (13) Minute eddy currents appearing in copper wires of the primary and secondary windings of coil and in the iron core of the coil. (14) Heat produced by eddy currents. (15) Magnetic hysteresis in iron core formed in overcoming molecular friction in the iron caused by reversals of polarity. (16) Heat produced by hysteresis in iron. (17) Infinitesimal variation in length of iron core due to magnetizing currents. (18) Moving electrostatic flux on the line accompanied by or producing electromagnetic flux around the wire. (19) Heat produced by passage of electric current through the wire. (20) Variation of the coefficient of friction between the surfaces of chalk cylinder and palladium-faced pen or spring of the motograph receiver. (21) Electrolytic action, causing evolution of hydrogen and oxygen between the chalk cylinder and palladium-faced spring of the motograph receiver. (22) Electro-capillary action, forcing moisture to the surface of the chalk cylinder of motograph receiver. (23) Variation in longitudinal stress of bar or spring attached to mica diaphragm of the motograph receiver. (24) Vibration of the diaphragm of motograph receiver producing variations in curvature of the diaphragm. (25) Sound waves through the air. (26) Vibrations of glass diaphragm of phonograph transmitter producing variations in curvature of diaphragm. (27) Variation in longitudinal stress of steel stylus attached to glass transmitting diaphragm. (28) Undulations in wax cylinder of the phonograph. (29) Variations in longitudinal stress of steel stylus attached to glass reproducing diaphragm. (30) Sound wave through the air. (31) Vibrations of iron diaphragm of carbon transmitter, producing variation of curvature of iron diaphragm. (32) Varying pressures on carbon button, varying the resistance of the carbon exactly in accordance with the number and amplitude of the vibrations of the diaphragm. (33) Pulsatory current produced in the primary winding of the induction coil. (34) Undulating magnetic force in the iron core of the coil. (35) Alternating electric current in secondary winding of the coil. (36) Minute eddy currents appearing in copper wires of the primary and secondary windings of coil and in the iron core of the coil. (37) Heat produced by eddy currents. (38) Magnetic hysteresis in iron core, formed in overcoming molecular friction in the iron caused by reversals of polarity. (39) Heat produced by hysteresis. (40) Infinitesimal variation in length of iron core due to magnetizing currents. (41) Moving electrostatic flux on the line accompanied by or producing electromagnetic flux around the wire. (42) Variation of the coefficient of friction between the surfaces of chalk cylinder and palladium-faced pen or spring of the motograph receiver. (43) Electrolytic action causing evolution of hydrogen and oxygen between the chalk cylinder and palladium-faced spring of the motograph receiver. (44) Electro-capillary action forcing moisture to the surface of the chalk cylinder of motograph receiver. (45) Variation in longitudinal stress of bar or spring attached to mica diaphragm of the motograph receiver. (46) Vibration of the diaphragm of the motograph receiver producing variations in curvature of the diaphragm. (47) Sound waves through the air. (48) Translation of sound waves into words by the auditory nerves and other mechanism of the ears of the audience at the Franklin Institute.

It is interesting to note that at the time of the lecture, by means of transmitters placed upon the stage, the lecture was listened to by audiences in fourteen different cities. Music and talking were transmited by the phonograph and telephone from the stage of the Franklin Institute to Buffalo, Rochester, Boston, Syracuse, New York, Newark, Orange, and elsewhere, through the courtesy of the Long Distance Telephone Company, who kindly placed their lines at my disposal for these original experiments.

Combined Telegraph and Telephone System.

Mr. W. E. Tiffany, Binghamton, N. Y., recently made some tests of his multiple telephone and telegraph system. The tests were made on wires between Binghamton and Oneonta, a distance of 61 miles. By this system, telegraphic and telephonic communications may be exchanged simultaneously over one wire.

A Cheap and Effective Window Attraction.

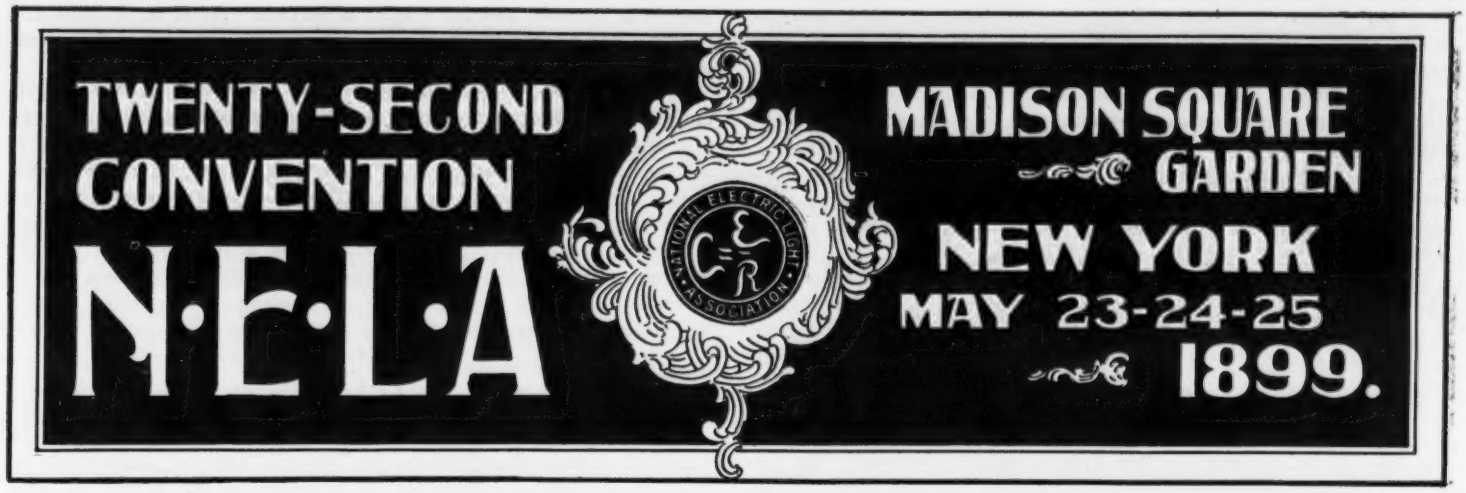
By P. H. KORST.

The following arrangement for a show window can be cheaply constructed, and makes an excellent display:

Procure a bicycle front wheel with axle but without a tire. Attach lamp sockets to the rim, one side being connected to a ring of copper and the other side divided into groups and attached to different segments of a commutator. Use colored lamps in the sockets, one color to each group. Attach a cylinder of wood 2½ inches in diameter and 4 inches long to one end of the hub, and smoothly mount on this the copper ring and commutator, which are easily made of 1 inch brush copper tacked to the wood. Mount the wheel by clamping the other end of the hub to a piece of iron, 1 inch by ¼ inch, firmly attached to the floor or wall. Balance by attaching bits of solder to the rim so that the wheel will revolve easily. Attach sections of cardboard, equally spaced, to adjoining spokes of the wheel in such a manner that the wind from a fan motor will set the wheel in motion. Connect the brushes bearing on the ring and commutator to the source of current supply, supporting them so as not to interfere with the motion of the wheel. Set a fan motor running with the fan in line with the hub of the wheel and regulate the motion of the wheel by speed of fan and distance from the wheel. By varying the speed and grouping the colored lamps differently, many beautiful effects may be secured.

Storage Battery Patents.

Three United States patents on storage batteries were issued May 23 to Frank King, of London, England; Leonard Paget, of New York, and Jules Julien, of Brussels, Belgium, respectively. The patent of the first mentioned inventor has for its object to lessen the fall in capacity which takes place in storage batteries when charged and discharged at high rates. The decrease in capacity under these circumstances is stated to be due mainly to the fact that when the current density is high, chemical action occurs principally at "the surface of the electrode electrically nearest to the electrode of opposite denomination"—whatever this may mean—and this decomposition of the surface is accompanied by the formation of sulphate of lead which obstructs and sooner or later closes access to the pores of the otherwise active material, thereby decreasing the capacity of the battery. In charging, this sulphate is reduced to pure lead, forming a layer which repeated discharges and charges make so dense as to be almost impermeable. In order to maintain a high rate of discharge and yet not exceed a proper surface density, the plate patented consists of a grid, beyond the surface of which the active material extends in the form of pyramidal projections. The patent of Leonard Paget relates to so-called dry batteries having an absorbent material for their electrolyte. In such batteries, at the end of charging the liquid of the electrolyte gathers on the surface of the absorbent material, making it necessary to provide space at the top of the cell into which it may collect, in order that the cell may not overflow. The patent provides for a vertical tube attached to each side of the positive plate, extending from the bottom of the plate to the top level of the mass of absorbent. Consequently the liquid from the electrolyte, instead of collecting on the surface, flows down these channels to the bottom of the electrode where it escapes into the absorbent or is carried by the action of the current into the mass of the same. In this way the liquid is pumped back into the absorbent as fast as thrown out, and the collection of an excess of liquid is thereby prevented. The Julien patent relates to a form of negative plate which is claimed to be of very great capacity and yet of great strength and durability. The negative element is formed by superposing a large number of sheets of rolled lead or lead alloy. As illustrated in the patent, the sheets are square in area and each contains nine square perforations; when completed the whole has the form of a cube perforated with nine square holes forming vertical chambers. The positive plate consists of nine pencils formed by molding litharge or other lead compound into the forms of cylinders or prisms perforated along their axis, which cylinders are then strung on conducting rods. As illustrated, nine of these assembled pencils are united to form a single positive electrode by attaching the rods to a common conducting frame, and the positive electrode thus formed is inserted in the respective vertical chambers in the negative electrode.



SYNOPSIS OF THE PROCEEDINGS.

The convention was called to order at 11 a. m. on May 23 in the Music Chamber of the Madison Square Garden, the room having been decorated for the occasion with plants and flags and with a sign in incandescent lamps, bearing the letters "N. E. L. A." There was an excellent attendance at the opening session, and indeed, throughout the meeting, and in spite of the many distractions of the exhibition it is said that the number participating in the regular business exercises was far beyond the average. President Young in calling the meeting to order said: "In opening the twenty-second annual convention of your association, I take great pleasure in welcoming you to the City of New York. I shall not attempt to enlarge on the beauties, advantages and wonders of this great city, because you all know it stands first among the cities of this country, and in many ways is the first city of the world—in electrical progress it has no equal. Within its limits are located thirty-five electric light stations, which furnish more than 1,000,000 incandescent lights, more than 30,000 arc lights, and at least 30,000-hp in electric motors. The capital invested for carrying on this great business is nearly $100,000,000.

"It may interest you to know that in 1897, in the City of Brooklyn alone, there were ten street railway companies having 678 miles of track, and a capitalization of $55,000,000. In that year these railway companies carried 223,180,504 people. Today, every transit company in the borough of Brooklyn is equipped or about to be equipped with electricity as its motive power, and the capitalization is $150,000,000, and 236,680,010 people were carried by this vast system in 1898. Electricity, together with the inventive genius of honored members of this association, has made this wonderful change possible.

"An editorial in one of the prominent Brooklyn journals speaking of the trolley, says: 'Their power houses are performing heart like functions, they are now pumping the blood of the cities through distant arteries where the flow was sluggish—they carry life with them.' I think not only are the trolley companies entitled to great credit for awakening the cities and towns all over this country to new life, but the electric light companies are also entitled to great credit in brightening up these cities and towns, showing the outside world they are alive.

"The evolution in the electric light business has been wonderful. At the semi-annual convention of the association held in New York, in August, 1885, the question of large and small engines and dynamos was discussed, and the late R. T. McDonald, of Fort Wayne, stated his experience at Peru, Indiana: They were operating a large plant, something like 165 arc lights, with two large engines and two large boilers. After running them a short time it was found no money could be made operating in this way. Small engines were substituted, after which the company earned good dividends. In some of the large cities at the present time are being erected, six thousand horse-power units of engines and dynamos, and in most of the electric stations throughout the country large engines and direct connected dynamos are the order of the day, and only by their use can the best economies be obtained.

The successful development of high tension service is making it possible to utilize the water powers that have been so long undeveloped. This service is revolutionizing the power question as to manfacturing business, in many of our prominent manufacturing towns, where formerly steam had been altogether employed. As we are all very much interested in the question of high tension service, I think we shall learn much that will be helpful to us, from the papers to be read on this subject, and from the illustrated lecture which will be given at this session.

It has been the aim of your president to secure for the benefit of the members of this association, papers by some of its prominent members, on practical every-day subjects which are nearest the hearts of electric light men and which help them in the operation of their own plants, and prove to them the value of this association. It will be very pleasing for you all to know that never in the history of the National Electric Light Association has its membership been so great, and never so much interest shown in its success. I sincerely hope the members will be very prompt at all the sessions, and that as many as possible will be present to listen to the valuable papers herein referred to. I now declare the twenty-second convention of the National Electric Light Association opened and ready for the transaction of business." Applause.

Mr. W. S. Barstow, of Brooklyn, N. Y., then read a paper entitled: "A Local Transmission System—Development and Operation," which was followed by discussion.

After some routine business the meeting then adjourned.

At the afternoon session, Prof. W. L. Robb, of Hartford, Conn., read a paper entitled "Rotary Transformers and Storage Batteries as Related to Long Distance Transmission," which was followed by discussion.

Prof. W. E. Goldsborough, of Lafayette, Ind., read a paper on "Transformer Tests" as a contribution to the topical discussion under that head.

The meeting then adjourned till Wednesday.

On Wednesday morning, the first routine business included the reading of a letter from Chev. G. Marconi, of London, who regretted his inability to attend the meeting of the association, an invitation having been sent to him some time ago.

Mr. Herbert A. Wagner, of St. Louis, then read a paper on "Single Phase Distribution," which was discussed."

Mr. Louis A. Ferguson, of Chicago, read a paper on "Underground Electrical Construction," which was followed by discussion.

At the Wednesday afternoon session, Mr. E. A. Leslie presented "Some Notes on Underground Distribution of Two-Phase Current in New York City," and Mr. W. L. R. Emmet, of Schenectady, contributed a paper on "Means of Affording Safety in Electrical Distribution."

Mr. J. I. Ayer, speaking for the committee on the standard candle-power of incandescent lamps, from whom a report was due, stated that progress had been made with the work, as already known. President Young stated that the matter would be taken up again in executive session, and a new committee appointed to continue the work,

No report was presented from the committee on legislation regarding theft of electric current. In its place, Mr. G. Wilbur Hubley, of Louisville, Ky., read a paper entitled "Transformers; Iron Loss; Its Increase; the Remedy."

The meeting then adjourned until the evening when a special session was held at which Mr. Calvin W. Rice, of New York, gave a popular scientific lecture on: "The Development of High Tension

Service." This was illustrated by over 100 lantern slides, many of which were made from photographs taken during Mr. Rice's own engineering work in the far West.

At the morning session on Thursday, President Young appointed the following gentlemen as the committee to nominate officers and three members of the executive committee for the ensuing year: J. I. Ayer, G. W. Hubley and H. H. Fairbanks. A paper was then read by Mr. H. M. Atkinson, of Atlanta, Ga., on "Alternating Current Generation and Distribution—Changes Contemplated in Atlanta," which was discussed.

On motion of Mr. Brown, of Columbus, the suggestion of Mr. Doherty that a committee be appointed to investigate and report on the photometric value of the various arc lamps was made formal and carried, the president being authorized to select such a committee.

The following resolution was then passed: Resolved, That the thanks of the Electric Light Association are hereby tendered to the New York Electric Vehicle Transportation Company, the Columbia Automobile Company, A. L. Riker Electric Motor Company, the Indiana Bicycle Company, and the Fischer Equipment Company, for the courtesies extended by them to the ladies of the convention, in the connection with the Automobile ride to Grant's tomb and Columbia University, Wednesday afternoon, May 24. Resolved, Further, that a copy of this resolution be sent to each of the above mentioned concerns by the secretary.

The following resolution was also adopted unanimously: Resolved, That the thanks of the National Electric Light Association be and are hereby tendered to Columbia University and to Professor G. F. Sever, of its Electrical Engineering Department, for the courtesies and hospitalities extended to the ladies of the convention on the occasion of the automobile ride, Wednesday, May 24, 1899.

On motion the meeting then adjourned in order to go into executive session. In executive session the first business was the report of the secretary and treasurer. The report showed the following financial transactions during the year:

Receipts and cash on hand..	$7188.90
Disbursements and liabilities.	4551 85
Balance	$2637.05

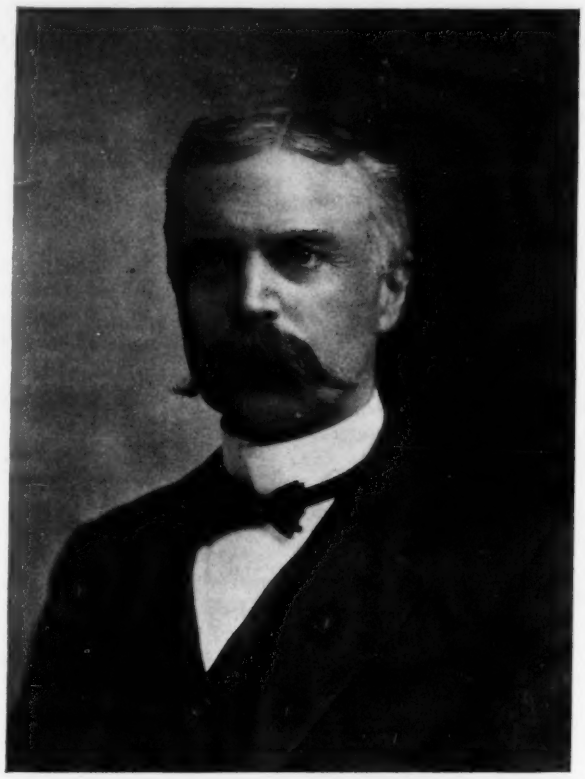
The report of the nominating committee was then presented: For president, S. T. Carnes, Memphis, Tenn.; for first vice-president, O. T. Crosby, Washington, D. C.; for second vice-president, J. B. Cahoon, Elmira, N. Y.; for members of the executive committee, E. F. Peck, New York City; William M. Brock, Paterson, N. J.; C. E. Scott, Bristol, Conn.

All these gentlemen were duly elected.

Mr. Crosby.—I propose a vote of thanks to Mr. Young. He has had, as we know, for years a ripe knowledge of the business we are engaged in, and his interest and industry in it have been unremitting. I do not believe that we could have had a better president to keep in for a second term, if it were not for the fact that the practice has been established of changing every year; but since that practice has been established and we are now to have Gen. Carnes as president, I move that the association tender a vote of thanks to Mr. Young for all he has done for the association during his incumbency. Carried.

President Young in acknowledging this courtesy said: I did not feel that I was the right person to be selected for this position when you elected me in my absence at Chicago. I thought it was rather hard lines to have the position apparently thrust upon me; but I felt that it was certainly a very great honor. I have tried my best to make this meeting a success, and I wish to thank every member individually for the great help he has given me, as without that help it could not have been a success. As it is, I think the meeting has been a great success and that the interest of the members present has been well sustained.

President Carnes on being escorted to the chair said: This is entirely a surprise to me, for I had no intimation of it until fifteen minutes since, and if I serve you with any sort of satisfaction, it will be another surprise to me. I am most highly gratified at this honor which you have shown me and will make every effort to serve you rightfully and faithfully. I hope that inasmuch as I have not been so fortunate as to cultivate the acquaintance of the individual members of this association, they will help me out and in some way give me an opportunity to see them personally. I hope to get closer to the great majority of members in this way.



PRESIDENT S. T. CARNES.

S. T. Carnes.

It is a noteworthy fact that for the first time in its history, and in a period of some fifteen years, the National Electric Light Association has elected a Southerner as president, in the person of Gen. Carnes, of Memphis. It is also not a little singular that in the person of Mr. Oscar T. Crosby, a vice-president has been found who is also a Southerner by birth, and who, in representing Washington, may be said to speak for that part of the country which is at least as much Southern as it is Northern. At the present time there is great activity in the South in all lines of electrical enterprise and development, and new central stations, railway power houses, power transmission enterprises and other plants are being constructed or planned on every hand. The growth of Southern mining has done much to stimulate the demand for electrical apparatus in the South, but the great spread of manufactures in the cotton States and the rapid increase in the population of cities like Memphis, Atlanta, Charleston, Norfolk, Chattanooga, Birmingham, etc., has been accompanied by a corresponding extension of light and power circuits at a very rapid rate.

Perhaps no man in the prosperous city of Memphis, Tenn., is better, more widely or more favorably known than Gen. Sam T. Carnes. The father of Gen. Carnes was one of the pioneers of Tennessee, and the son is worthy of the sire. Barring a brief period of childhood, Gen. Carnes has spent his life in Memphis. He was born in Hardeman County, West Tennessee, in 1850. He was by birth and inclination a soldier, and his early training and tendency have gone far toward making him one of the best known military tacticians in the South. For a long time he was brigadier general of the State of Tennessee, thus having charge and control of all the militia of the State. This military talent was both inherited and cultivated. His father before him was a military enthusiast and expert, and was at one time at the head of the State National Guard. Gen. Carnes was elected captain of the Chickasaw Guards, of the city of Memphis, in 1878. It was at that time decidedly the best military body in the State., and one of the best in the nation.

To Gen. Carnes is due the introduction of both the telephone and the electric light in Memphis, and he has been for years the president and general manager of the Memphis Light and Power Company. Gen. Carnes was married in 1881 to Miss Kate Kerr, of Memphis, and has two daughters, aged fourteen and sixteen.

It is not understood that the election of a Southern president implies any intention of taking the convention South next year, much as this would be liked by many of the members. The Association is at present alternating between New York and Chicago, and so far as is known at present the practice will be maintained, although it is said to have disadvantages.

Some Convention Papers.

As will be noted from the general report of the National Electric Light Convention, several important papers were read. Their publication, with the discussion, in abstract, is begun below:

ALTERNATING CURRENT GENERATION AND DISTRIBUTION-CHANGES CONTEMPLATED IN ATLANTA.

Mr. H. M. Atkinson, in a paper with the above title, stated that his company, having concluded to increase the capacity of its plant, was this spring confronted with the alternative of adding in conformity to its present equipment, or departing from past methods and taking a radical new start.

At present the station has seven large engines, all of different sizes and types. Most are belted to counter-shafting to which are belted thirty-seven small units. Three kinds, or perhaps more correctly, four kinds of current are generated and distributed. The shafting is arranged to give great flexibility and enable the engines to work at their best steam economy. The engines are compound condensing, include one of 1000-hp and belted to a two-phase alternator used to generate single-phase current. The dynamo-room contains a number of small 1000-volt alternators, three different kinds of direct-current series arc machines and four different kinds of power machines. The small alternators work at 125 cycles while the large direct-belted unit works at 133 cycles. The different kinds of current generating to-day are as follows: 133-cycle, 1000-volt, single-phase; 125-cycle, 1000-volt; 500-volt direct-current; 500-volt direct-current railway; 10-ampere direct-current arc, from three kinds of machines; and to do this work thirty-seven dynamos and generators and seven exciters are operated.

The plan adopted is to send the electrical output to the distributing wires—whether for direct-current, series alternating-current arcs, direct-current series arcs or any other kind of business—from large generating units of similar design and type working in multiple. By doing so there will be a lower expense per kilowatt than with smaller units, and certainly as great flexibility as with the shafting, as the source of current is brought to one spot and that direct-connected to the steam-power. The three main points to be settled were periodicity, voltage and single or polyphase generation. A frequency of sixty was adopted as being adapted to both lighting and power. A voltage of 2300 was adopted as the lighting center is not over a mile from the station, and will probably not exceed one and one-half miles to the most distant motor. Should the field at any time be extended to greater distances, step-up transformers can be used in case the line losses shall overbalance the transformer losses.

The most difficult problem was to decide as to the type of generator. Single-phase distribution was adopted as being the best for incandescent lamp service. On the other hand, polyphase currents are required for power service. It was anticipated that the development of the business will almost certainly require a constantly increasing power for motor work, and this being the case, and all other conditions being equal, it seemed best to employ the form of generator that is most economical in copper cost for motor distribution. This feature influenced a decision for three-phase generators. It is intended to take the three primaries to the larger motors and to use induction regulators on each of two phases, regulating the third phase by the machine voltage and keeping this just right for the three-wire network carrying three-quarters of the incandescent-lighting load. A good point about the three-phase generator selected is that it will, if only one phase is loaded—that is, run single-phase—take 70 per cent. of its rated load, on one phase at practically its three-phase efficiency. This is a case that probably never will occur in practice, but it is a point in favor of the generator.

The street lighting at present consists of the equivalent of 870 9.6 ampere series arc street lights and 70 commercials. The plan contemplates ultimately taking these lights off of three-phase generating units, either on the motor plan, using induction or synchronous motors and large arc machines, or "tubs" and series alternating arcs. For certain reasons it is undecided as to which of these plans will be used. In either case, the next unit would be similar to the one just bought, and of such a size as to take care of the street lighting and the after-the-peak incandescent load, with a reserve for natural increase, and would run straight through the night with an economical load. This unit would have to be about 1000-kw. The unit just bought, of 400-kw capacity, will take care of the day incandescent as well as any new power work, and would with the larger unit just mentioned, take care of the peak of the incandescent load as it stands at present. These two units, one of 400-kw and the other of 1000-kw, will be overloaded to the limit of safety as the business grows, and then there will be added another large and duplicate set, all three running in multiple and dividing the load between them. There is a leeway of a good many months in which to decide whether to run the arcs from station motors or "tubs," and these additional months will be of great importance in reaching a decision.

As large transformers as possible will be used on each phase, the number being kept down to a minimum, and they will feed into the three-wire network. These transformers will be placed underground in the central section of the city, and as the load drops off, the trouble man, who is constantly on duty at the office within this district night and day, will cut off unnecessary transformers. This will save the loss on such transformers as can be cut out for a large part of the twenty-four hours.

Single-phase motors of 1-hp and less will be used. For heavy power work it is intended to use induction motors running from motor transformers with the third wire brought across. If found necessary, as anticipated, to continue and perhaps increase the 500-volt power circuit, there can be used in this connection a rotary transformer.

It is believed that the plan as outlined above will accomplish the following results:

First, Large and few units, which mean economy in steam and steam attendance; second, multiple running, which means even service and the highest efficiency in engines and generators, by keeping as nearly a full load as possible at all time; third, by using motors to drive the arc machines, attendance will be cut down and a saving effected in repairs, belting losses and losses in shafting; or should the decision be for "tubs" and series alternating arcs, all the foregoing and the additional advantages of steadiness, reliability, less attendance and higher efficiency, will be attained; fifth, incandescent customers will be served as perfectly as with a single-phase plant; fifth, if the 500-volt motor circuit is continued for some classes of work, it can readily be run from rotaries and so increase the day load on the generating units.

The discussion which followed the reading of Mr. Atkinson's paper had a wide scope and was the most lengthy of the meeting, consisting largely of an interchange of views between central station managers present on various subjects.

Mr. Scovil said that his company was thinking of rewinding its present 125-light Brush machines, so that they might take care of enclosed arc lamps. Mr. Dunham said that the economy of street lighting is very much greater with the series alternating system. Mr. Wright said that his company would most probably rewind its 150-light machines in order to run series alternating arcs from them.

Dr. Kershner said that there appears to be a confusion of ideas concerning the amount of light from direct-current and alternating current lamps. A direct-current arc has all its light right under it and people are consequently apt to consider when they come within the cone of light that it is superior to the series lamp, which distributes its illumination more efficiently. Mr. Ayer said that he remained over night in Hartford for the purpose of seeing the series alternating lamps in operation, and he found that they gave better illumination than most constant-current high-tension arcs.

Mr. Doherty said that it is discreditable to the electrical profession that we do not know more of the photometric value of arc lights. The distribution of light is the essential thing and unless the series open arc lamps are placed high up or close together there is a very uneven illumination from them. Mr. Doherty stated that he would like to see the association take up this subject and investigate the photometric value of various arc lamps.

Mr. Scovil stated that his company runs 1200 constant-potential direct-current arc lights and 200 enclosed alternating-current lamps. There has been considerable trouble with the enclosed alternating lamps, but lately this has been somewhat overcome. The chief difficulty has been not so much the question of light as that of noise. When placed together the light from the alternating arc appears to be somewhat less than from the direct current, and consumers in the outlying section would prefer to have the direct-current arc for this reason.

Mr. Bean said that he recently procured some direct-current enclosed arc lamps and his customers are extremely well pleased with them.

Prof. Goldsborough stated that the direct-current enclosed arc lamp is more efficient than the alternating-current lamp on the basis of the watts consumed and the lower hemispherical candle power. As regards the watts per candle, Prof. Matthews found the consumption to be 3½ to 4 watts or almost as high as in the case of the incandescent lamp. The experience in the City of Lafayette with the alternating enclosed arc lamp has been very satisfactory and the people generally prefer it to the open arc lamp.

In answer to a question Mr. Ayer said that all commercial heating apparatus is equally effective and efficient with either direct or alternating current, and with any number of phases or periodicity.

Mr. Crosby said he thought that to-day we are as near sweeping the horses off the streets with the automobile as we were in 1889 in taking them off the tracks with the electric car.

In reply to a question as to the bearing of the automobile question on central-station systems, he said that he thought this was largely a matter that will have to be worked out by each central-station with respect to its own peculiar circumstances. At present automobile storage batteries are charged from 110-volt circuits. It will be more economical to have but few charging stations.

Mr. Scovil said that in Cleveland a gentleman who owned an electric carriage had a local manufacturer make for him a rotary transformer and the battery is automatically charged from it at night, the rotary taking current from the alternating mains. At present a half dozen people are proposing to have similar installations.

Mr. Doherty considered that if any man can afford $3000 for an automobile he can afford the extra investment for a motor-driven dynamo in a stable from which to charge the battery.

Mr. C. A. Lieb said that in New York City, the Edison Companies supply current to automobiles at a minimum rate of 5 cents a kw-hour and that the automobile people guarantee to haul 1000 pounds in the streets of New York for .6 of a cent per hour on this basis, which is much below horse transportation. Mr. Lieb considered that owners of automobiles would probably take the vehicle in at night and charge it from the 110-volt house circuit. The firm of B. Altman is putting in an automobile plant to displace the horse, and they can put in twice the number of vehicles in the same space occupied by the horses, wagons and fodder.

Mr. Edgar considered that the next five years is going to see such a large development in automobile work that it will be the second largest portion of central-station business. He believed that the great bulk of vehicles will be charged from central-station service mains, whether direct or alternating. In the latter case current would be transformed by the vehicle company by means of rotaries. Mr. Edgar does not believe that there is any possibility that a system of charging stations at every street corner will come into use. In a city like New York charging posts would probably have to be erected in fifty places, mostly in the outskirts. He said that he was connected with an electric launch company and appreciates that the great drawback in the use of electric boats has been the prevalence of the alternating current, and he thinks that the widespread use of the alternating system has also been a drawback to the automobile business.

Mr. Doherty did not think the matter hinged on direct or alternating currents, as any one who can run an automobile can also run an alternating-current motor driving a dynamo furnishing direct current.

Mr. Lisle said that the Narragansett Electric Light Company met the condition by putting in a motor on the 500-volt service running a 110-volt generator. The installation was placed in the stable of a department store and has been successfully handled for some time by green men.

Mr. Lieb said that possibly automobile companies may generate electricity themselves, which would affect unfavorably the electric lighting situation; he believed the best thing for them to do is to buy current for 5 cents per killowatt-hour, between midnight and 6 o'clock in the morning.

Mr. Barstow concluded the discussion, giving a view of the situation in Brooklyn with respect to the use of alternating and direct-currents. The real question was as to which system would be of the greatest service to the users of the current. At the time the problem was taken up in Brooklyn the matter of supplying Coney Island had to be considered and the problem was solved by establishing there a sub-station, transmitting to it at a voltage of 6000 and distributing both alternating and direct currents. The result at the end of a year and a half is that 100-kw of alternating and 150-kw of direct current are being used and it is difficult to keep up the supply of direct current. The tendency seems to develop the heavy part of the business in the city proper with direct and keep the alternating current as a pioneer system to build up the outskirts. Whenever, however, the two systems come together, the alternating system has been squeezed out. Mr. Barstow said that to him it appeared that direct current is going to be the outcome. In adopting an alternating current of 25 cycles in Brooklyn the question of being able to furnish current to other services was taken into consideration. In New York City the plant of the Metropolitan Street Railway Company has exactly the same frequency and voltage as in Brooklyn, and the Third avenue railway has also adopted the same frequency.

MEANS OF ATTAINING SAFETY IN ELECTRICAL DISTRIBUTION.

In presenting his paper with the above title, Mr. W. L. R. Emmett stated that he had not selected the subject with the intention of discussing all of its features, but rather for the purpose of bringing to the notice of the association certain matters of practical importance concerning which radical differences of opinion exist, and also for the purpose of pointing out some of the new problems presented by recent developments in the electrical art.

Of the three principal sources of danger in electrical distribution—heating of conductors by current, failure of insulation and arcing when circuits are intentionally or accidentally broken, the first mentioned has an adequate safeguard in the use of cutouts capable of safely breaking any current to which they can be subjected. As to the second, where power is transmited at high voltage there is but one sure means of obtaining security on parts of the circuit where life and property can be endangered, and that is, by preventing the existence of a high potential on such circuits. Some of the methods by which this end can be accomplished were them considered.

Fig. 1 shows the simplest arrangement of a primary and secondary circuit as they are now generally installed in this country, and illustrates a condition under which such an arrangement may become dangerous. The dotted lines show connections that may be accidentally made, one being a cross between the primary and secondary either in the transformer or out of it, and the other a connection of one of the primary leads to the ground. The primary voltage being 1000 and the secondary 100, the making of these connections immediately establishes a potential difference of 1100 between part of the secondary circuit and the ground. This pressure will, as a rule, be too much for the insulation of combination fixtures, and the first indication of trouble is likely to be a fire, if it be not a shock received by some one who happens to establish a circuit through his body between the ground and some lamp socket or other part that is not sufficiently insulated from the secondary circuit.

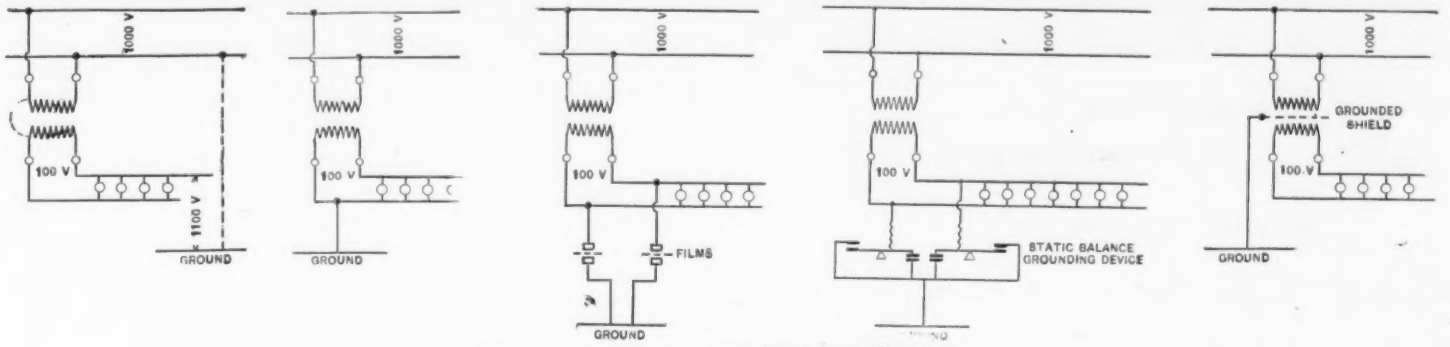
With the arrangement shown in Fig. 1, it is also quite possible that the secondary insulation may be subjected to a considerable part of the primary voltage, even when there is no ground connection on the primary circuit. The potentials of insulated circuits carrying currents tend by static induction to balance themselves with respect to the ground, so that the potential to the ground is normally neutral to that of the two conductors. Where circuits are long and operated at high potentials, a considerable flow of current between one conductor and ground may be required to materially disturb this neutrality. This is sometimes illustrated by the lighting of ground detector lamps from circuits that are perfectly insulated. When a secondary becomes crossed with a perfectly insulated primary, these static-capacity currents tend to flow to ground through the secondary insulation, and under these most ordinary conditions on 2000-volt circuits are of sufficient volume to light ground-detector lamps, and therefore of sufficient amount to cause, under certain conditions, a fire.

The remedy for the trouble must be either in a permanent connection to the ground, as in Fig. 2, which is, however, now prohibited by the underwriters; or in the installation of some device by which the secondary is grounded automatically when the emergency arises. Figs. 3 and 4 show methods used to accomplish this latter purpose, and Fig. 5 shows a method for preventing contact between the primary and secondary of a transformer by the introduction of a grounded shield, which has been used to some extent. The objections to the method of Fig. 5 are that it affords no protection against crosses between primary and secondary occurring outside of the transformer, and also the expense, since the shield must be made heavy enough to carry current sufficient to blow the primary fuses, and at the same time so arranged that it will not introduce serious eddy current losses; in addition, it probably renders the transformer more subject to injury from lightning.

Fig. 3 shows the secondary separated from ground by films of insulating material which are intended to puncture when the voltage to ground rises above a certain point. The objection to this method is that the films are liable to be uncertain and variable in their insulating qualities, and may under certain conditions be punctured by the secondary pressure. Fig. 4 shows how the same object may be accomplished by means of a static balance whose motion by rise of potential difference causes the circuit to be grounded. Another device has been suggested in which a magnet is placed in series with a vacuum tube between the secondary and ground. When the potential difference rises the discharge through the tube is increased and the magnet starts mechanism which grounds the secondary circuit. The objection to the above devices is that they are not perfectly instantaneous in action, and that the secondary insulation may break down elsewhere before they act; besides, they are also necessarily more or less complicated and therefore liable to fail on that account.

As to the permanent grounding of transformer secondaries, there may be several desirable exceptions to the underwriters' prohibition. For example, in a rotary converter, the collector rings and commutator connect to the same winding, so that the direct-current leads are as much a part of the transformer secondary system as if they were directly connected to it, and most of the present companies employing rotary transformers have for years been operating with the neutral conductor grounded. Fig. 6 shows the condition existing in such cases. First, the secondary system to which all house wiring is connected, is permanently grounded; and, second, a primary voltage of 6000 is used. In spite of these violations of the underwriters' rules, the circuits are just as safe as they were before the high-tension power was used, and safer than they were before the neutrals were grounded.

Mr. Emmett considers that the rules prohibiting this condition should be abandoned, because, first, they lead to danger rather than safety, and second, because they endeavor to fix an unnecessary barrier to progress. A forcible illustration of the danger of ungrounded secondaries was afforded by a recent occurrence in New Orleans. In a residence district where the houses were connected to a system of three-wire alternating mains, a cross caused by wind occurred between one of the main wires and a 2000-volt primary wire in the same street. The result was that the insulation between the wiring and the ground was broken down in a large number of the houses, the trouble being principally in combination fixtures where conductors were near gas pipes. Fires occurred in twenty houses, several were totally destroyed, and the loss was over $200,000. If the neutral of this system of mains had been grounded, this trouble could not have occurred.



FIGS. 1 TO 5.—DIAGRAMS OF GROUNDED CIRCUITS.

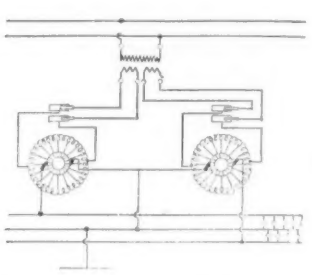


FIG. 6.—ROTARY TRANSFORMERS ON GROUNDED CIRCUIT.

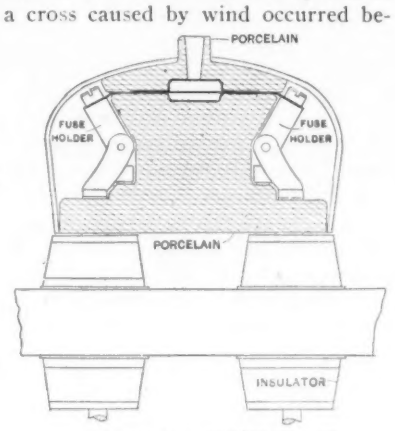


FIG. 7.—TENSION FUSE.

The rule of our underwriters which prohibits the grounding of secondary wiring is not supported by the practice of other countries, for in Europe, the secondaries are very generally either grounded or protected by some such automatic devices as above described. There is but one condition necessary to safety with a properly grounded secondary—that there be no possibility of the accidental introduction to the secondary system of sufficient primary current to blow the secondary fuses. No possible state of conditions can arise where this precaution cannot be observed, since portions of primary circuits occupying the same streets with secondary mains can easily be protected by fuses, if the total primary current capacity exceeds that of the fuses of the secondary mains in question.

The third cause of danger, as stated before, is arcing through accidental opening of circuits, or through failure of circuit-opening devices. Most fuses, switches and circuit breakers now in use for alternating-current work are strictly limited in the range of their safe action, and would be valueless on a circuit capable of delivering a large amount of power. As an example, in the new station of the New York Metropolitan Street Railway Company, about 50,000-kw will be delivered to a single set of bus bars, and from there distributed all over the city. For every substation or other installation that is connected to these lines, means must be provided by which the circuit can be broken instantly in case a short circuit occurs. The power of this station is generated and distributed at 6000 volts, and the loss in lines will be small, so that the violence of a short circuit in the substation will be almost as great as if it were on the main bus bars.

As the power units become enlarged it will be necessary to provide means for limiting the total amount of power that can be delivered to individual branches. This object can be accomplished by inserting reactances in these branches, so proportioned that they do not materially interfere with the normal operating conditions and yet capable of limiting the total power delivered as to keep it within the safe range of the circuit-opening devices.

Fig. 7 shows a circuit-opening device for such circuits as here considered, consisting of a fuse block in which the fuse is in a state of tension between two hinged terminals pulled apart by springs and receiving current through flexible connections. The fuse is punched out of sheet metal, the narrowest portion being in the middle. It is placed between two blocks of porcelain, a small amount of clearance being provided where the fuse passes through, so that its ends can be freely withdrawn by the movable terminals after the narrow part of the fuse has been ruptured. Around the narrow part of the fuse the porcelain blocks are recessed so as to provide an air chamber which is vented by a hole in the upper block. The whole device is firmly clamped together, so that the only opening to the outer air is through this one vent hole. The fuse, being under tension, does not quite reach the melting point before the break occurs. It loses its tensile strength at a low red heat and pulls apart. It is quickly withdrawn by the springs from the air chamber in which it has been broken. A very small amount of the metal is volatilized and its gas is blown out of the vent hole. For the purpose of preventing any deposit of metal fumes on the porcelain surfaces, these surfaces are lined with muslin that has been treated with shellac or varnish and

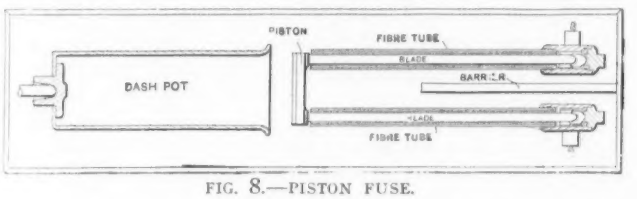


FIG. 8.—PISTON FUSE.

pressed into the desired shape. This lining covers the interior of the chamber in which the fuse is broken and the porcelain surfaces between which the fuse is drawn. These linings are supplied with the new fuses and are renewed if any appreciable amount of burning has occurred. With a fuse of this type occupying a space of 6 inches by 9 inches on a switchboard, 300 amperes at 13,000 volts have been repeatedly broken without the slightest injury to the device.

Fig. 8 illustrates the principle of a circuit-breaker that has produced excellent results. Two terminals are placed side by side on a vertical board, and are separated, both in front and behind the board, by high barriers. Into the metal surrounding these terminals stout fibre tubes are attached which extend downward on either side of the barrier. Two copper rods, connected at the bottom by a crosshead, are inserted in these tubes, and forced upward until they make contact in the terminals; the circuit is thus established through the copper rods and the crosshead around the lower extremity of the

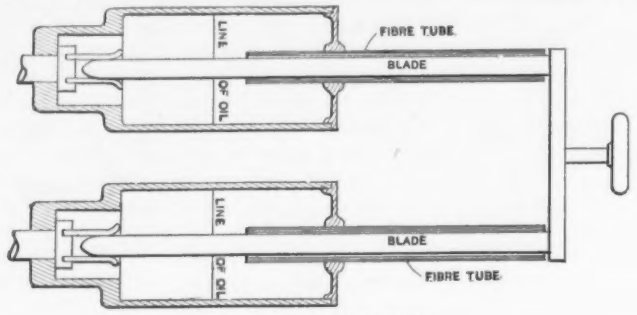


FIG. 9.—OIL-BREAK FUSE.

barrier, and through the fibre tubes. The crosshead carries a piston, and this piston moves in a long, air dash-pot. To set the circuit-breaker, the rods are forced upward, by means of a wooden rammer, until the contacts are made; in this position the rods are held by a latch controlled by a solenoid. When the proper amount of current is put thro gh this solenoid the latch is released; a spring starts the rods downward, so that the circuit is broken in both tubes, the acceleration being checked by the dash-pot. This device has been found very effective on the heavy circuits with which we have experimented. It occupies a small amount of space, and is simple in its mechanical construction.

Fig. 9 illustrates the construction of a switch or circuit-breaker somewhat similar in principle to that shown in Fig. 8. In this case the terminals are at the lower end, and are situated inside of vessels into which the fibre tubes project for a short distance. These vessels are partly filled with oil, the break occurring below its surface. In the switches of this type that have been constructed, the rods have been withdrawn from the tubes by a pneumatic cylinder. The presence of the oil materially increases the breaking power of the switch and reduces the violence of the explosive effect when the circuit is opened.

Fig. 10 shows a shunt device that has been used in connection with circuit breakers at Niagara Falls and elsewhere. The object of the design is to produce a fuse that can be placed in shunt with the circuit-breaker, to open the circuit after the main contacts are broken. It is, of course, desirable so to design such fuses that they can be very easily replaced. The fuse is placed in a slot in a long, wooden rod; this wooden rod is covered by a paper tube, and part of the wood is cut away at three points, so as to form air chambers inside

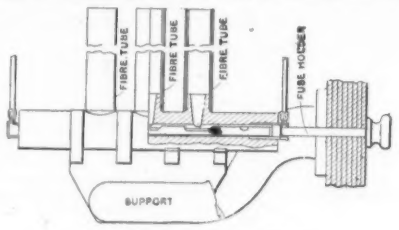


FIG. 10.—SHUNT FUSE.

of the paper tube. The rod is inserted in a long, wooden tube provided with vents that come opposite to these air chambers when the fuse is in place. The fuse is a small copper wire, and is attached to ferrules on the rod which make contact with springs at both ends of the tube. When the current is diverted into the fuse, which immediately volatilizes, the pressure in the chambers bursts the paper opposite the vents and the gas escapes through chimneys provided above the vents. The paper covering of the rod prevents the hot gas from getting into the interior of the tube; consequently the device can be used over and over again without any deterioration. These fuses have worked perfectly in parallel with circuit-breakers under the most difficult conditions that could be produced.

Another form of fuse which has been found very effective for difficult conditions, consists simply of a short piece of glass or porcelain tube with terminal at each end, and an asbestos lining to prevent burning of the porcelain. The objection to this type is that the gas is blown with great violence from both ends of the tube, and must be diverted from surrounding conductors, or else short circuits are liable to be caused by it.

In the discussion which followed, Mr. Emmett stated that the size of the shunt fuse shown in Fig. 10 depends upon the quickness of the opening of the circuit-breaker. The fuse is normally in parallel with the breaker, and the circuit-breaker may be actuated by a coil from the series transformer or an outside source. Its self-inductance must not be very large, otherwise there will be a lag in breaking. If the fuse blows before the breaker is opened to any appreciable extent, the circuit may fail to open, but if it opens beyond the striking distance before the fuse blows, it will operate. At Niagara Falls a No. 20 copper wire is used on the breakers opening 1000-ampere circuits, and there has never been a failure in operation.

Mr. Barstow said that when the 6000-volt three-phase Brooklyn system was started two years ago it seemed almost impossible to get any fuse that would operate positively, and the first short-circuit that occurred entirely wrecked the switchboard. The fuse illustrated in Fig. 8 was tried under the name of the cannon switch or piston fuse, which in some cases would blow four or five feet. One day a large crane happened to be directly over one of the cabinets containing these fuses, there being a distance of about four feet between the cabinet and the bottom of the crane; an accident happened on the line, the fuse went off, and the rods striking the crane girder were short-circuited through it. The fuse at present in use in Brooklyn is similar to that of Fig. 7, and is made of aluminum.

Mr. Greene called the attention of the association to the desirability of united action on the part of the electrical interests to secure a modification of the present Fire Underwriters' rules, prohibiting the grounding of the neutral. Any rule opposed to good engineering practice is bound to be modified sooner or later. If the one in question continues in force, much property may be destroyed, as the accident which occurred in New Orleans is bound to be repeated under the conditions which exist now, particularly where there are overhead conductors.

WAGNER ON SINGLE-PHASE DISTRIBUTION.

In opening his paper on single-phase distribution Mr. Herbert A. Wagner stated that each alternating-current system had its own particular province, and that in the transmission of power and to operate large motors, both two and three-phase systems are superior to the single-phase. Among the disadvantages of polyphase distribution the multiplication of wires is the very least, the complication of switchboard apparatus and appliances, and also those used in connection with local distribution and services being most discouraging. As to the copper saving claimed for the three-wire system, the actual difference in the cost of conductors installed for underground transmission on the single and three-phase systems is almost insignificant, for the reason that the cost of installation, conduits and other construction items does not increase in proportion to the cross section of the copper. Moreover, to overcome what difference may exist would require an increase of pressure for the single-phase system amounting to not over 10 per cent. in pressure for overhead lines and less than 15 per cent. for underground lines. Mr. Wagner considers that for regulation the single-phase is far superior to the two and three-phase systems. In either the two or three-phase system an unbalanced load on the different phases causes an unbalancing of the pressure on those phases at the generator and consequent difficulty in close regulation, this being most marked in the three-phase system.

For long-distance transmission, for power purposes and running rotary transformers only, the three-phase system is most clearly indicated; for the same service with a small proportion of lighting, three-phase currents may be transformed to two-phase for the latter, or single-phase may be used from one of the three-phase circuits. For shorter distribution and general distribution where rotary transformers are also requied, the two-phase system is indicated. For all general distribution where rotary transformers are not required and extremely large motors starting under load are not to be supplied. Mr. Wagner considers that the single-phase system should always be used.

While single-phase rotary transformers of large capacity have not yet been made, Mr. Wagner said that they can be so designed as to operate as satisfactorily as polyphase rotaries. They would, however, for a given size have less capacity and therefore for a given capacity would cost slightly more.

The distribution system of the Missouri Edison Electric Company, of St. Louis, was referred to, and pronounced probably the best existing example of pure single-phase distribution on a large scale. In a large portion of the city the usual overhead system with individual transformers is used. The principal business portion of the city is now supplied by underground conductors covering a district of forty miles of street. A low-tension Edison three-

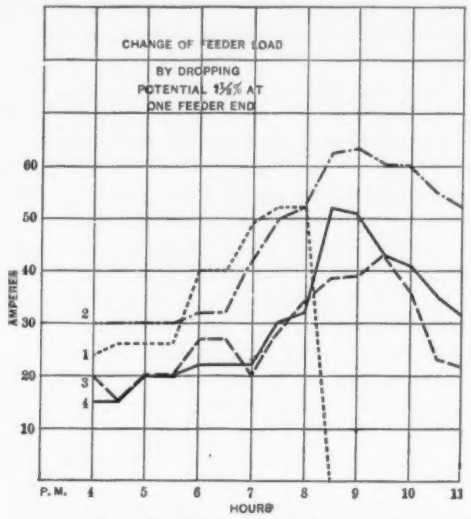


FIG. 1.—SHOWING EFFECT OF CHANGES OF FEEDER LOAD.

wire network of mains is used throughout this district, the mains being supplied by high-tension feeders, each of which terminates in a transformer of the same capacity as the feeder. The pressure wires run from the mains at the terminals of each transformer back to the station, and each main has a regulator and booster at the station. From this network of three-wire single-phase alternating-current mains, current is furnished for incandescent and arc lamps and motors. At present there are 1000-hp of single-phase motors in operation varying in size from ½ to 25-hp, many having replaced direct-current 500-volt motors; and without exception they are all giving perfect satisfaction.

The novel feature of this system is the method of making the transformer practically a part of the feeder, to which its drop is

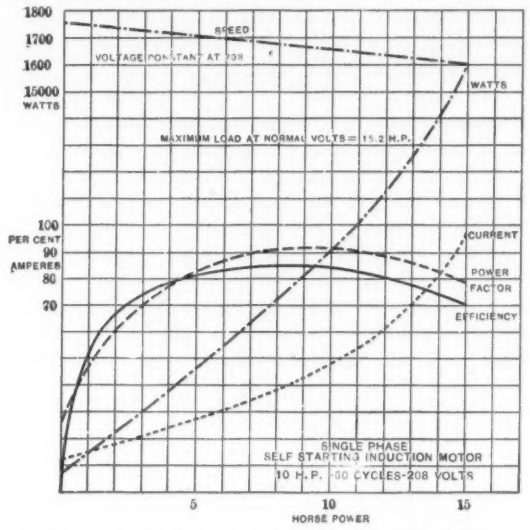


FIG. 2.—CURVES OF 10-HP SINGLE-PHASE MOTOR.

added and cared for by the feeder regulator at the station. The pressure wires indicate the pressure on the secondary mains, which can be kept constant, however much the drop in the feeder or transformer may vary. The transformers were designed for remarkably high average efficiency and actually show the highest efficiency at about one-quarter load. Thirty of these, of 110-kw capacity each, are in service on as many feeders. Tests on six of these picked out at random gave an iron loss of from 231 to 250 watts; a copper loss of from 3050 to 3200 watts; efficiencies at quarter load 98.4 per cent in each case; efficiency at full load, from 96.8 to 97.1 per cent.; regulation from 3.38 to 3.50 per cent. The highest recorded load on any transformer was 130 kw.

The feeder regulators at the station make it possible not only to regulate the pressure with the greatest precision, but to divide the load between the feeders and the transformers in any way desired. By slightly lowering the pressure on one feeder and slightly raising it on an adjacent one, a large proportion of all of the load of the first can be transferred to the second without sensibly altering the pressure on the mains. This operation is almost identical with that of dividing the load between two direct-current generators running in parallel. All feeders can be kept almost equally loaded in this way, if desired.

The effect of the slight drop in pressure on one feeder when the load is transferred from it to an adjacent feeder or feeders is shown by the curves in Fig. 1. Here the pressure of feeder No. 1 was dropped 1½ volts. Feeders Nos. 2, 3 and 4 promptly took their proportion of the load, leaving feeder No. 1 practically without load, which latter could then have been cut out of service, if desired, leaving the portion of the district about its terminal 1½ volts low in pressure. This, however, is on the assumption that the other feeders were allowed to remain at the original pressure, but by means of their regulators the voltage of each or any one could be raised slightly and the pressure at the terminal of No. 1 thus brought to approximately a normal figure with only a slight raise of the terminals of the other feeders.

All feeders are provided with fuses at the station end and the secondary terminals of each transformer are led into junction boxes provided with copper fuses, these latter protecting the rest of the system in case of any defect developing in a feeder or its transformer.

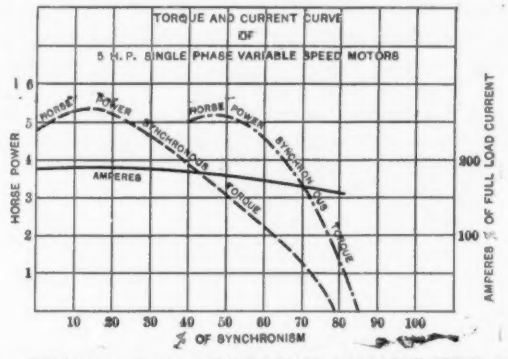


FIG. 3.—CURVES OF 5-HP SINGLE-PHASE VARIABLE SPEED MOTOR.

The method of eliminating the effect of transformer drop by making it a part of the feeder, renders it possible to regulate, with a system of interconnected mains and using pressure wires, as closely as in the case of a direct-current system; and the use of individual feeder regulator enables the pressure to be adjusted with the greatest precision. The average station load is 950-kw, the maximum being 2000-kw. The efficiency of the underground system of distribution at the average load is 92.4 per cent., the following being the distribution of the losses in kilowatts: Feeders, 30; transformers, iron, 7.5; boosters, iron, 4.8; transformers, copper, 10.2; boosters, copper, .5; secondary mains and house wiring, 19. At 1520-kw the distribution efficiency is 90 per cent. and at 100-kw 87.7 per cent.

On this system of underground distribution the ratio of customer's meter readings to station output reaches 82.6 per cent. As stated before, the greater portion of the overhead distribution of the company referred to is by individual transformers, one to each customer, and as a large proportion of the current supplied in this way is used in residences, the load factor is very low, the ratio of customer's meter readings to station output being only 48.3 per cent.

The 1000-hp of alternating current motors connected on the lines of the St. Louis company vary in size from ½ to 25-hp. The efficiency is stated to be as high as that of direct current or polyphase motors, and the construction fully as simple and free from complication. The type used for constant speed is started and stopped by a single switch placed in any location and without the use of a rheostat or controller. A commutator is used to secure the required torque in starting and to bring the motor up to speed, after which it is entirely disconnected.

In Fig. 2 are given efficiency and power factor curves of a 10-hp single-phase motor. Many single-phase motors for variable speed work are used on service where full torque is required at varying

speed, such as in driving direct-connected elevators, operating direct-connected fans, etc. These are operated without a commutator, but require a controlling device for varying the speed. In Fig. 3 are given the torque and current of a single-phase variable-speed motor. The torque curves, taken at different positions of the controller, show that full-load torque can be obtained at any speed from zero to full speed. The motor, in fact, can be controlled with as much ease as a series direct-current motor in such a way as to get a constant torque at all speeds.

Mr. Wagner states that so far there has not been a single demand on his company for any purpose for which electric current has ever been used which it has not been able to supply efficiently from its single-phase alternating current mains, and this leads him to state positively that single-phase currents can be used for general distribution to supply all requirements.

In answer to a question as to the effect of elevator motors on lighting circuits, Mr. Wagner stated that he has repeatedly taken friends from out of town to see the motor installation and he has failed yet to find one who could tell when a 25-hp motor was started or stopped by looking at the lamps connected on the same circuit.

Mr. Emmet, in referring to the advantage of the single-phase system in permitting interconnection of the mains, said that there is a means of using polyphase apparatus by which the same result may be obtained and a single-phase circuit run from such apparatus. Assuming that in the case of the St. Louis installation a three-phase machine were operated instead of a single-phase machine, the whole secondary distribution load, high tension and low tension feeders, would be supplied by one phase of the three-phase machine; the other phases could be utilized for outlying distribution and the house-to-house transformer work which has to be controlled by feeder regulators in any case. The voltage of the dynamo in this case would be applied to the distribution for the low tension system and the other circuits would be operated and controlled by feeder regulators. A three-phase machine may be operated as a single-phase machine and give two-thirds of its capacity. In one instance, the General Electric Company had installed a single-phase dynamo and subsequently three-phase dynamos were added, which were identical with the single-phase machine except that the latter had one set less of coils. By installing a three-phase dynamo instead of a single-phase dynamo, the user has the option of employing three-phase motors, if he prefers them, and can also transmit to any distance and operate large motors to advantage, and can do a general alternating power distribution work. In addition, when direct current is needed, a rotary converter can be run; with all these advantages, he will still have a dynamo which will give as much single-phase current with just as good regulation as any machine which can be built for the same cost.

In reply to a question from Mr. Crosby as to whether there can be devised any form of alternating current system as flexible as a direct-current system to meet the demands for both light and power, Mr. Wagner replied that thus far in St. Louis no class of work has been found which could not be as readily taken care of with single-phase as with direct-current motors; that a direct-connected elevator motor can be run perfectly satisfactorily with the single-phase alternating current motor, and that with a well-designed interconnected system of three-wire mains, the pressure will not be affected more than in the case of a direct-current motor and system. It is a question of installation and wiring to prevent the pressure from being affected, and not a question of the motor. The size of the wire and the class of installation is very different from that used for running the same size of direct-current on the three-wire Edison system, and equal results cannot be expected if this distinction is not observed.

Mr. L. A. Ferguson stated that the Chicago Edison Company appointed a committee of engineers to investigate the subject of a distributing system for alternating current in the outlying territory, and the result of the investigation was that the company could not afford to put in alternating current motors larger than 2-hp in that territory, for the reason that motors of larger sizes affected the pressure so badly as to jeopardize the lighting business.

Mr. Wagner, replying, said that motors larger than 2-hp can be used in the outlying territory of St. Louis, which corresponds to the same section of Chicago, if the mains and feeders are carefully looked into; but this would also have to be done with the direct-current system where provision had been made only for distribution for lighting service. He added that he did not see how outlying distribution could be done in any other way but with alternating current, unless it be by alternating current transmission and transformation to direct-current; if the latter is done, however, the mains and feeders will have to be redesigned and if the same care were given to the alternating current circuits, using the same mains and the same distribution system, there would be as good regulation as with direct-current. The reason why good regulation has very often not been obtained with alternating currents is because the distributing system has not been designed with the same care as for direct-current, it often being considered that almost anything would do for the alternating current. In the outlying districts of St. Louis motors are employed up to 20-hp and there is no complaint from regulation. Mr. Wagner did not think it of advantage to use motors of more than 25-hp any lighting system in any one place except where the mains are very large and there is a large amount of current.

Mr. Perkins gave an account of a visit to a large newspaper power installation referred to in the paper of Mr. Wagner, and stated that though motors as large as 25-hp were used, he could detect no variation in the lights when all of them were started. Mr. Perkins stated that his experience in visiting different installations was that there must be a sufficient generator capacity back of the motors, and he said that at Youngstown when there was a 75-kw alternator on the circuit the lamps jumped whenever a 3-hp motor was started, whereas there was not the slightest flicker when a 350-kw alternator was connected up.

Mr. Emmet agreed with Mr. Perkins that it is a question of the machine and not of the system of distribution. If enough copper is put in and high enough voltage is used, any desired effect can be gotten at any point. It is not only a question of the size, but of the inherent regulation of the machine; machines can be proportioned in such a way as to give a large or small drop of potential with changes of load, and if regulation is not essential, it is rather desirable not to make the machines too close in inherent regulation. In very large installations where many large machines are run in parallel, it is less important to use close inherent regulation than in small installations where single machines and small machines are run with motors of variable load. Many of the large alternators recently installed regulate to within 5 and 6 per cent.; the large alternators recently installed in Boston regulate to 4½ per cent.—that is, the change of voltage when the whole load is thrown off and on is only 4½ per cent.; the alternators having a capacity of 2000-kw, it can readily be seen that even a 500-hp motor in starting could not appreciably affect the voltage of such a machine.

In reply to a question by Mr. Crosby as to what system he would use in extending service where a direct current at present is used, Mr. Emmet said that the solution of this question must always depend on local conditions and on investments already made. Both direct and alternating current distribution systems and motors have their peculiar advantages, but the question of deciding which to establish and which system shall grow cannot be settled by laying down any generalities, but is a question for the engineer. In some cities where there is a very large load practically evenly distributed as in New York, the direct-current is ideal with a secondary network. The advantages of the direct-current only apply to districts where it can be distributed in a compact interconnected mass of mains. When it is extended, however, and where customers are to be supplied in separate groups, difficulties appear. The direct-current is suited to cases where you can put a large amount of power in one substation in which there may be operated rotary converters as transformers. In small systems substations are not required with alternating currents, and transformers are all controlled from the main station.

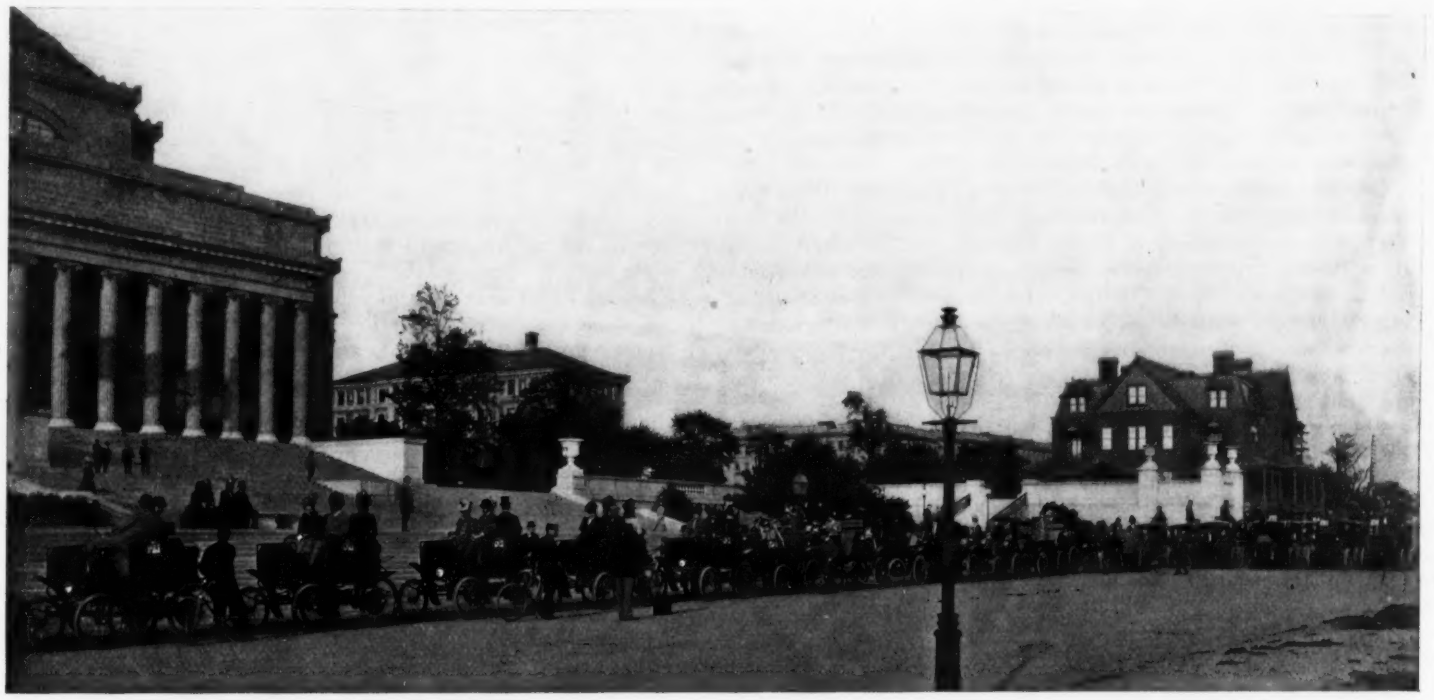
Mr. Creden said that granting that the alternating current is equally as satisfactory as the direct-current, the investment is less for an alternating current system than for a direct-current system in a district where the generating system is removed not over one mile from the distributing centre.

Mr. Stetson said that while the single-phase system has its advantages, two-phase and three-phase systems are respectively best adapted under certain conditions. By dividing a territory into two zones, the direct-current is best for the central zone while for the outlying zone there is no question that the alternating is best.

In answer to a final question, Mr. Wagner said that in general, conditions permitting, the alternating current should be used in all extensions made to outlying districts. The outlying districts will ultimately be the main sources of revenue, and his advice in the absence of definite conditions is to use the alternating system for extensions to such districts.

Automobile Ride of the National Electric Light Association.

One of the familiar events of a meeting of the National Electric Light Association has been a ride to some park or pretty suburb of the city in which the convention is held. Hitherto horse carriages have been used, or a special batch of street cars, but in view of the fact that electric automobiles are a leading attraction of the electrical show now being conducted under the auspices of the Association at Madison Square Garden, it was felt that a new departure was in order. To go out and hire horse carriages would be ridiculous, and therefore the Entertainment Committee proposed that only automobiles should be used and only electrics at that. When an investigation was made, however, it was found that probably not more than fifty such vehicles would be available, and it was resolved to limit the ride to the ladies of the cenvention as far as possible. Under these circumstances, it was decided to give the ladies an electric automobile excursion to Grant's Tomb on May 24, in the afternoon. Hearing that it was also proposed to take refreshments at the adjoining Claremont Hotel on the bluff of Riverside Park, engineering friends at Columbia University extended an invitation to take afternoon tea there and inspect the various buildings.



A LINE OF FORTY-EIGHT ELECTRIC AUTOMOBILES IN FRONT OF COLUMBIA UNIVERSITY LIBRARY, NEW YORK.

The members of the Entertainment Committee having the affair specially entrusted to them were Messrs. E. F. Peck, H. L. Shippy, J. W. Godfrey, C. O. Baker, Jr., and T. C. Martin, and with these were associated Prof. G. F. Sever, of Columbia University. Messrs. Fred. Vieweg, of the Electric Vehicle Co.; A. L. Riker, president of the Riker Co.; Mr. J. M. Hill, of the Columbia Automobile Co.; I. H. Kuh, of the Woods Motor Vehicle Co.; H. G. Osburn, of the American Vehicle Co., and R. M. Barwise, of the Indiana Bicycle Co. After a great deal of preliminary work, due to the novelty of the idea in this city and the difficulty in obtaining the necessary facilities, police and park permits, etc., no fewer than forty-four electric carriages lined up at 3 p. m. in front of Madison Square Garden, and it is significant that by invitation the first photograph was taken from the home of the Society for the Prevention of Cruelty to Animals just opposite, on invitation of President Haines. The line included an extraordinary variety of stanhopes, brakes, dog carts, runabouts, victorias, hansoms and broughams, and as each vehicle was loaded with three or four persons, no fewer than between 130 and 140 started on the ride. It had been intended to reserve the seats entirely for ladies, except those for the committee, but some "gentlemen" who were not accompanied by ladies crowded in by sheer force and a few ladies were thus sadly disappointed.

The trip up Fifth avenue to Grant's Tomb was made very successfully, in spite of the fact that the squad of bicycle policemen at the head of the line changed the official route and threw in a succession of steep hills at the end of the run that it was wholly unnecessary to include. It is said that this was done with deliberate purpose, but if it was intended to "pocket the parade" and bring it to disaster, the attempt failed most ignominiously. On reaching the last crest, the carriages were not allowed to enter Riverside Drive, but after their occupants had visited the Tomb the march was resumed and the next stop was made at Columbia University Library, where several excellent photographs were taken of the line. Private automobiles having joined in, there were now forty-eight automobiles present. After tea in the West Hall, Prof. Sever and staff escorted the party through the new gymnasium and swimming tank and through the engineering and electric plant. About 5:30 the march was resumed. The members of the party were given liberty to break from the line for special visits or trips in upper New York city, but nearly forty of the carriages stayed together and came home down Central Park West, on the western side of Central Park, Mr. Riker leading the way at a speed that could not have been less than twenty to twenty-five miles an hour. The return to the Garden was duly made, and in spite of all the dismal predictions of fizzle and failure, not a single vehicle failed to get home after the run of twelve to fourteen miles. The first automobile ride of the National Electric Light Association was a huge success.

Many interesting incidents attended the affair. Messrs. Edwin and Frank Gould placed their vehicles at the disposal of the Association. Col. A. A. Pope came on from Boston to take a prominent part, and at the last moment the pressure brought to bear on the committee to obtain seats was little short of extraordinary. No small credit for the success of the ride is due to Mr. Vieweg and to Mr. Hadley, of the New York Electric Vehicle and Transportation Co., which took twenty-five vehicles out of its daily service in the city to accommodate the Association in order to help make the ride a success.

A Convention Dinner at the Lotos Club.

Among those identified with electrical work in New York city are several members of the famous Lotos Club, and the happy idea occurred to these gentlemen to signalize the close of the convention of the National Electric Light Association on Thursday by a dinner at the house on Fifth avenue. The subscribers to the dinner were Messrs. A. M. Young, C .W. Price, W. G. Bushnell, J. G. Ward, H. F. De Puy, E. H. Wells, C. O. Baker, Jr., G. G. Heye, H. H. Harrison, G. H. Walbridge, R. H. Shainwald and H. L. Shippy. Among those who accepted the invitation were Messrs. O. T. Crosby, F. A. Gilbert, C. R. Huntley, Felix Campbell, E. F. Peck, T. E. Murray, H. S. Anderson, J. H. Vail, T. C. Martin, J. I. Ayer, G .A. Redman, W. L. Robb, H. H. Fairbanks, E. A. Leslie, L. A.

Ferguson, C. A. Terry, L. Stieringer, G. F. Porter, Marcus Nathan, S. L. Coles, H. Hayes, Mr. Webster, J. G. White and S. Scovil. It is needless to remark on the representative character of the gathering, and on the zest with which, after an extremely busy convention week, the whole party resolved itself into a jolly crowd of good fellows. Some present had seen the development of the whole art of electric lighting in this country, and others had followed the career of the Association from the very start. A perfect dinner was followed by a number of brief speeches from Messrs. Young, Price, Gilbert, Martin, Terry, Hunter and Vail, and the small hours of the morning were reached all too soon. The guests were all highly appreciative of the hospitality extended to them, and were slow to break away from the big table, arranged like a magnet, to which their Lotos friends had bid them such hearty welcome. It would seem that here is an example worthy of imitation in the future, so that the Association, wherever it goes, or whether it sticks to New York and Chicago, can enjoy this social and club recognition in the cities that it visits.

The Excursion to Schenectady.

On Friday, May 26th, the delegates to the convention of the National Electric Light Association were the guests of the General Electric Company, who provided for them a most enjoyable trip to Schenectady.

A special train of eight palace cars carried the visitors over the New York Central railroad, leaving the Grand Central depot at 8:35 a. m. and running as a second section of the famous Empire State Express. About 170 guests, ladies and officers of the company, were on board. Schenectady was reached at noon and the train was run into the yards of the works.

Of the many buildings scattered over the 230 acres of this great manufacturing establishment, the first visited was the new iron foundry recently described in these columns. The party passed through this building rapidly, anticipating the inspection of more finished electrical machinery of greater interest. From this building the visitors scattered somewhat into separate parties, guided by the company's representatives, who had accompanied the party from New York City, assisted by several members of the engineering staff resident in Schenectady.

Among the various buildings visited and the apparatus of interest seen in them were the following:

In the armature disc department were the many punching machines for stamping out and notching the laminated plates for armature cores, handling in the course of a month between 600 and 700 tons of sheet iron. The visitors were greatly interested in the annealing furnaces with their grooved railroad track running through from end to end on which cast iron boxes are run on cannon balls, carrying punched and slotted plates into, through and out from the furnaces. The processes of japanning the plates by means of rollers like those of a printing press and drying them by carrying them under compressed air nozzles were also of interest to the visitors.

In the armature assembling department the visitors unacquainted with this style of work were astonished at the coil-forming machines, on which sufficient copper wire for one coil is simply wound into a pair of straight slots on a device which by a few simple movements twists the wire into the complex shape of an Eickemyer formed coil. In the same department the armatures are tested after they are wound, and the visitors were shown in operation the ingenious laminated horseshoe magnets, the poles of which embrace an armature and by means of an alternating winding in the magnet set up therein a very intense alternating field which generates high e. m. fs. in the windings, that break down the insulation at any weak point. The same testing equipment contained high tension transformers for testing the dielectric strength of the insulating materials used in the high voltage work, and one of these was shown delivering some 55,000 volts to terminals on opposite sides of a sheet built up of shellac and mica plates, used in insulating high-voltage machinery. Fine blue static sparks ran from the terminals in all directions but found no point of weakness through which they could break. The same test was applied to a sheet of glass, soon finding a weak point which broke down.

In the power station the most interesting apparatus seen was the battery of double-ended rotary converters with two commutators, two sets of collector rings and two electrical windings on one armature in one field frame. These peculiar machines are designed to act as three-wire sets to supply the three-wire distribution around the works, taking power from the hydraulic system and transmission line from Mechanicville.

The old iron foundry is now being fitted up for transformer work and here there were seen under construction some transformers for Niagara Falls, which will be when completed unsurpassed in size, their rated output being 1870-kw or 2500-hp each. They are of the oil insulated and water cooled type, enclosed in boiler iron tanks, of such a size that their appearance suggests water tanks or gas holders more than electric machinery. The transformers proper are of the shell type with coils wound in a horizontal plane and these embody a brand new principle of cooling. The primary and secondary coils are thin, flat sheets or straps wound edgewise and interleaved and between them are flat brass tubes, piped to carry the cooling water; thus the cooling effect is brought in as intimate contact with the source of heating as by any practical method that can be imagined. Another transformer of interest is one with a ratio of 100 to 100,000 volts, its rated capacity being 35-kw.

Scattering over the works the visitors saw also the heavy enclosed turret turning motors for the Russian battleships now building; two of the 990-kw six-phase rotary converters for the Metropolitan Street Railway Company; the first six-phase rotaries ever built; several 200-kw induction motors with a most ingenious arrangement of the windings by which the number of poles can be doubled by simply throwing a switch and the speed of the motor thereby cut in two without any material change of the slip or efficiency. In the line of railway motors, four of the one hundred gearless machines ordered for the Central London Underground, looking more like fire and burglar-proof safes than railway motors, are still in the shops. The armatures of these motors, mounted rigidly on the axles with the car wheels pressed on at either end, have an odd appearance to eyes accustomed to geared machines. One of the 225-hp geared motors for the Paris-Orleans line was under test at the time of the visit.

Among other machines of interest were the frequency, voltage and phase changers used by the Brooklyn Edison Company, some double current, low voltage generators for working on Edison mains; marine sets, consisting of vertical tandem compound engines, direct-coupled to 50-kw dynamos, of which many have been delivered to the government; a large revolving field three-phase Y-connected alternator for service in England, the common point of the Y being brought out to a fourth terminal for grounding, and other novelties in dynamo construction almost too numerous to mention.

The visitors witnessed a test of an electrically-equipped fire department, the apparatus consisting of a Worthington pump driven by an induction motor. Some of them also found the searchlight department of interest, in which some large searchlights for the government, taking as high as 90 amperes, were under construction or test in finding a target located three miles away up the Mohawk Valley, a requirement of government specifications.

The switchboard department had one big board built on an order from the South African General Electric Company of Johannesburg, and another remarkably handsome board for the battleship "Illinois." Several railway panels marked for cities in France were being assembled as were some 10,000-volt panels for Pueblo, Colo.

At 5 o'clock the parties, who had scattered throughout the works and had been given unlimited freedom to see and hear explained all they wished, assembled in one end of one gallery of the mammoth new machine shop. Here an electrically-cooked dinner was served by a New York caterer. Following the dinner a few speeches were made, limited both in number and length by the necessity of starting on the return trip at 7:30. President C. A. Coffin, of the General Electric Company, welcomed the visitors to the works and spoke feelingly of the recent death of Mr. John Kreusi. Mayor Duryea welcomed them to the city and Gen. S. T. Carnes, the newly elected president of the National Electric Light Association, responded gracefully, and a vote of thanks was proposed by A. M. Barron.

The special train arrived in New York City at midnight.

Among those representing the General Electric Company on the excursion were: President C. A. Coffin, Gen. Eugene Griffin, S. Dana Greene, E. H. Mullin, Caryl D. Haskins, F. C. Willcox, C. A. Gundecker, F. C. Bates, Charles Hughes, T. Beran, H. N. Boyer, W. B. Hayes, J. R. McKee and C. A. Lighthipe.

Mr. Tripler's Lecture on Liquid Air.

By special invitation of the National Electric Light Association, Mr. Charles E. Tripler gave a lecture on liquified air in the concert hall at Madison Square Garden on Friday evening, May 26. The room was crowded to suffocation by an audience of over 1500 people, who were most enthusiastic in their reception of the lectures and his remarkable experiments, although hundreds of them had to stand. Mr. Tripler's work in making the manufacture of liquified air practical and commercial has become widely known and does not need to be here described. His demonstrations on Friday night, in which he was assisted by Mr. W. H. Meadowcroft, were most fascinating. Some of them consisted in freezing various substances in the air whose temperature being 312 degrees below zero, Fah., at once rendered them hard and brittle. Strawberries became stones; beefsteak could only be broken with a hammer, butter crumbled in icy dust. Mercury was taken and frozen into a hammer with which nails were driven through an inch plank; and a cross bar was also made of frozen mercury, to which Mr. Tripler and a boy hung at the end of a rope from the ceiling until the rope broke, while the mercury stayed stiff and inflexible. The weight thus sustained was about 300 pounds. Alcohol was also frozen easily.

Another curious experiment was that of boiling the air by putting a kettle of it on a block of ordinary ice. The kettle was then placed on a burning gas stove, whereupon frost formed all over the outside and ice accumulated inside so that it rattled. The expansive nature of the air was also shown by making small quantities of it drive missiles and corks from guns, blow whistles, etc. The air was taken for these and many other experiments from a special tank capable of holding several quarts, and was used very freely. The aspect of the stage with the air expanding and rolling off in great fog banks was very curious. The people in front shrank instinctively from the threatened wetting, but were more than puzzled when they found that the liquified air had left no trace behind on them or their clothes. After the lecture, the platform was literally mobbed by hundreds from the audience.

Convention Notes.

MR. FRED B. SMITH, of Boston, was present with a few samples of the specialties he handles in the New England territory.

FRANK RIDLON & CO., of Boston, were ably represented by Mr. E. W. Kellogg, though Mr. Ridlon's smiling face was much missed.

THE PETTINGELL-ANDREWS COMPANY, of Boston, was in evidence as usual, Mr. Chas. B. Price looking after its interests in his usual careful manner.

THE ELECTRIC GAS LIGHTING COMPANY, of Boston, was represented by Mr. W. F. Abely, who knows everything about gas lighting apparatus and open circuit batteries.

LYNN INCANDESCENT LAMP COMPANY, of Lynn, had a popular representative at the convention in Mr. E. F. Dwyer, who knows all about renewing incandescent lamps.

THE BIBBER-WHITE COMPANY, of Boston, was ably represented by its ever-popular representatives, Mr. T. H. Bibber and Mr. D. W. Dunn, who kept things moving generally.

THE JEWELL BELTING COMPANY, of Hartford, had on the ground its popular representative, Mr. Chas. E. Newton, who can always talk interestingly even on such a dry subject as belts.

THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., were represented at the convention by Mr. W. Bryant and Mr. G. M. Scribner, who looked after the interests of their multitudinous friends.

THE PHILLIPS INSULATED WIRE COMPANY, of Pawtucket, was represented by Mr. H. O. Phillips, whose knowledge on the subject of insulated wires is always at the disposal of his numerous friends.

THE ANCHOR ELECTRIC COMPANY, of Boston, was well represented by Mr. Norman Marshall and Mr. Harry Bottomley, who secured a great deal of attention from the delegates when speaking of Anchor specialties.

THE CHASE-SHAWMUT COMPANY, of Boston, had present Mr. Sears B. Condit and Mr. H. B. Moore, without whom an electric light convention would be incomplete. They had a lot of interesting news to give out about their recent consolidation.

THE EDDY ELECTRIC MANUFACTURING COMPANY, of Hartford, was represented as in the past by Mr. A. D. Newton and Mr. M. E. Baird, the latter of whom came on all the way from Chicago to attend the convention. It would be strange to have a convention without these two familiar faces.

THE SIMPLEX ELECTRICAL COMPANY, of Boston, had Mr. James I. Ayer on the ground to look after the interests of its heating department. Mr. Ayer was also busy at the convention endeavoring to get some concerted action relative to general reduction of freight rates on electrical apparatus.

THE AMERICAN CIRCULAR LOOM COMPANY, of Boston, were represented by Mr. A. T. Clark and Mr. J. M. Wilson in addition to its New York representative, Mr. R. B. Corey, and its general sales agent, Mr. Harry B. Kirkland. Many expressions of regret were heard that Mr. H. H. Brook's continued illnes made it absolutely impossible for him to attend.

THE WEST was remarkably well represented as will be seen in the general list of names. A large special party came over together from Chicago, but they were only a portion of the western delegation.

MR. W. S. LOW was present in behalf of the Electric Appliance Company, of Chicago, and was accompanied by Mrs. Low, both of them finding a host of friends in the East.

THE MURRAY HILL HOTEL was the official headquarters of the association, and the stopping place of most of the out-of-town delegates. Its corridors and halls were thronged during the week, but the resources of the hotel were adequate to every emergency, and Mr. Jaques and his associates, who have entertained the association before, once more received many congratulations on the success of their efforts to take good care of everybody.

THE BOSTON PARTY came over by special drawing room car to Fall River and thence by the "Priscilla." It was about forty strong. On arrival in New York, two tally-ho coaches met the delegation and conveyed it to the Murray Hill Hotel, Secretary G. F. Porter, representing the reception committee. The whole affair was carried out under the management of Mr. R. F. Ross, to whom much credit is due for his careful attention to the details of the trip, securing a maximum of pleasure and comfort for all concerned.

DR. W. M. HABIRSHAW gave a convention dinner to some twenty friends, on Tuesday evening, May 23, in the Pink Room, at Delmonico's, Fifth avenue. Among those present were: Messrs. Young, Huntley, Gilbert, Urban, J. W. Lieb, Jr., Barstow, Edgar, Ferguson, Hall, Price, Martin, M. J. Insull, Isham, Stillwell and Kennedy. The dinner was a masterpiece of selection and service, and the doctor's hospitality was unbounded. The evening passed in a most delightful manner with speech, anecdote and recitation, and will be long remembered by those who were so fortunate as to be present.

THE PHILADELPHIA CONTINGENT attending the convention was large and included Messrs. F. S. Stevens, of the Keystone Electrical Instrument Company; C. E. Trump, of the Novelty Electric Works; E. M. Wilkins and Chas. Wilkins, of Partrick, Carter & Wilkins; L. P. Clark, J. Mustard and C. Cresswell, of the Wagner Company; George Vallee, of Vallee Bros.; H. C. Roberts, of H. C. Roberts Electrical Supply Company; C. A. Bragg, of the Westinghouse Company; F. H. Stewart, of the F. H. Stewart & Co.; H. T. Paiste, P. C. Cloud, of the General Electric Company; Mr. Wickersham, of the Franklin Electrical Supply Company.

A STEAM BOAT TRIP around New York waters was one of the features planned by the entertainment committee, and was carried out in splendid style on Thursday by Messrs. Shippy, Candee, Beran and Price, who gave it their special attention. The boat "Isabel" was chartered for the occasion and stages took the ladies from the Murray Hill Hotel to the pier at East Thirty-first Street. The start was made about noon, and the boat went far up the Sound. She then returned and went down to Staten Island to see the battleship "Massachusetts" lying at anchor off Tompkinsville. She next headed north and went as far up the Hudson as Grant's Tomb. The trip ended about 5 o'clock at the pier from which the start was made. During the day refreshments were served by Mazetti and as music was provided, dancing was indulged in by those who still considered themselves young enough. Throughout the day, glorious sunshine but cool weather prevailed, and the trip was voted a huge success by the two hundred people who went on it.

BRIXEY'S KERITE was represented during the convention by Mr. Brixey himself. This famous make as Day's Kerite has been known to two generations of electrical engineers and is now becoming known to a third.

STANDARD UNDERGROUND CABLE CO. were represented at the Garden during the convention by Messrs. G. L. Wiley, eastern manager; E. W. Dugdale, superintendent of construction, and A. B. Sawman, assistant manager.

THE HART MANUFACTURING COMPANY, of Hartford, was represented by Mr. Gerald W. Hart, who showed samples of his latest invention in push flush switches, which he has aptly named the Diamond H. Most of the central station and supply men appeared much interested in its latest type of push switch, and it looks as if Mr. Hart would do a large business in them.

THE HART & HEGEMAN MANUFACTURING COMPANY, of Hartford, was represented at the convention by Mr. A. H. Pease, of Hartford, and Mr. Wm. Taylor, of New York. The Hart switch is so well-known that it requires little talking, but Mr. Pease met many of his friends in the supply business, who are all regular customers and who have the happy faculty of always coming back for more.

List of Registered Attendants at the Convention:

Abadie, E. H.
Ackerman, P. C.
Adams, H. C. Jr.,
Adams, T. H.
Aberly, W. F.
Alexander, P. H.
Alexander, W. J.
Almert, H.
Anderson, H. C.
Atkinson, H. M.
Ayer, James I.

Babson, A. D.
Bagan, D. B.
Baird, M. E.
Baker, C. O., Jr.
Barnes, F. O.
Barker, F. E.
Barr, M. D.
Barron, A. M.
Barron, A. N.
Barstow, W. S.
Barwise, R. M.
Bates, F. C.
Bean, W. W.
Beran, T.
Bibber, T. H.
Bigley, J.
Bisle, A.
Black, J. S.
Blakeslee, G. G.
Blizard, Chas.
Booth, T. B.
Bosworth, C. F.
Bottomley, H.
Boyer, F. N.
Brady, P. T.
Bradley, C. L.
Braeley, J. M.
Bragg, C. A.
Brewster, L. O.
Brock, W. M.
Brophy, C.
Brown, J. O.
Brown, W. H.
Bryant, W. C.
Buck, H. C.
Buddy, H. J.
Bullen, D. R.
Burgener, W. H.
Burland, A. E.
Burt, B. T.
Bushnell, W. G.

Cahoon, J. B.
Campbell, F.
Candee, W. L.
Carnes, S. T.
Carnes, W. W.
Carrier, A. E.
Chandler, E.
Church, J. V. S.
Clarke, A. T.
Clark, F. O.
Clark, L. P.
Clark, W. J.
Clifford, A. E.
Cloud, P. C.
Cockey, M. R.
Codman, J. C.
Coghlin, J. P.
Cole, D. S.
Coles, S. L.
Coliseh, J. C.
Collins, W. F.
Condict, G. H.
Condit, S. B., Jr.
Conley, W.
Conn, S. G.
Cook, G. C.
Corey, R. B.
Corson, W. E.
Coughlin, W. H.
Cowperthwait, G. E.

Crain, S. I.
Crawford, H.
Creden, T. H.
Cresswell, G.
Crocker, J.
Crown, J. B.
Crosby, O. T.
Crossman, T. E.
Crowell, H. H.
Cunder, J. M.
Cutter, H. B.

Danforth, B. O.
Daniels, A. I.
Davenport, G. W.
Davis, E. H.
Davis, D. L.
Day, W. A.
DeCamp, A. J.
DeCamp, H. C.
Dee, A. U.
Deming, W. M.
Doherty, H. L.
Dresser, R. E.
Dugdale, E. W.
Dunlop, A.
Dunn, D. W.
Dusenberry, G. B.
Dwyer, E. F.

Eckert, W. H.
Eckert, W. S.
Edgar, C. L.
Edgar, H. T.
Edwards, H. O.
Estinghausen, C. H.

Fairbanks, H. H.
Farnsworth, H. C.
Farr, E. H.
Fawcett, C. E.
Ferguson, J.
Ferguson, L. A.
Field, A. W.
Fleming, R.
Flood, T. W.
Foster, H. A.
Foster, P. B.
Francisco, M. J.
French, T. T.
Fuessewick, F. F.

Gallaher, R. E.
Gardner, F. F.
Gartland, C. C.
Garton, T. W.
Garton, W. R.
Garvey, C. W.
Geiser, J. F.
Gessler, S. G.
Gilbert, F. A.
Gille, H. J.
Gilman, H. K.
Girviss, W. H.
Glasborough, W. G.
Godfrey, J. W.
Godkin, M. L.
Goff, D. L.
Golding, F. H.
Goldsborough, W. E.
Greaves, J. M.
Gray, H. C.
Greene, S. Dana.
Griffin, T. L.
Gring, D. E.
Guir, E. R.
Gundaker, C. A., Jr.
Guy, G. H.

Habirshaw, W. M.
Hague, C. A.
Hale, R. S.
Hallegan, F. M.
Hand, W.
Hanley, H. J.
Hannan, E. S.
Harding, W. H.
Harper, T. J.
Harrington, F. W.
Harris, M.
Harrison, H. H.
Hart, G. W.
Harthan, C. E.
Haskins, C. D.
Hawkins, F. M.
Hayes, W. C.
Hays, W. F.
Hayward, E. G.
Hazeltine, W. P.
Hedenberg, W. L.
Hewitt, C. F.
Heywood, A. S.
Hill, F. Y.
Hill, J. M.
Hoag, G. M.
Hodgins, W. H.
Hollan, G. W. G.
Holmes, W. E.
Holmes, R. C. P.
Hovey, P. H.
Howe, L. P.
Hubbard, W. C.
Hubley, G. W.
Hughes, C. E.
Humphrey, C. B.
Hunt, C. B.
Hunt, W. T.
Huntley, C. R.
Hurlburt, S.

Insull, M. J.
Irvine, J. C.
Issertel, H. G.

Jackson, G. J.
Jahl, A. C.
Jameson, H. M.
Jenkins, F. R.
Johns, S. D.
Johnson, E. H.
Johnston, W. J.
Jones, A. J.

Kammeyer, C. E.
Kech, T. P.
Kellar, D.
Kellogg, E. W.
Key, E.
Key, W. S.
Kilgore, A. C.
Kimball, A. H.
Kirkland, H. B.
Kornfeld, A. E.
Korst, P. H.
Kuh, I. H.

Lantry, A. B.
Laufketten, F. C.
Learned, C. A.
Learned, W. A.
Leslie, E. A.
Levine, L. M.
Lieb, C. A.
Lieb, J. W., Jr.,
Lighthipe, J. A.
Lindsay, S. C.
Low, F. R.
Low, W. S.
Lozier, R. T.
Lupke, P.

Mercein, T. R.
Meek, S. G
Merritt, M. H.
Miller, J. H.
Moore, H. P.
Moore, J. D.
Moore, R. E.
Moore, W. E.
Mullin, E. H.
Murphy, J.
Mustard, A. H.
Mustard, J.
Myers, F. J.
MacConnell, W. J.
McCabe, E. F.
McCarty, N.
McCluen, G. H.
McGraw, J. H.
McIntire, C. A.
McQuaide, J. P.
McRoy, J. T.
McVickar, W. B.
Magner, G. P.
Manson, G. T.
Manson, D. E.
Manwaring, A. H.
Marshall, N.
Martin, T. C.
Marx, C. D.

Nathan, M.
Neal, G. B.
Newell, I. O.
Newell, L. C.
Newton, A. D.
Newton, C. E.
Norton, P. T.

Osburn, H. G.

Paiste, H. T.
Park, F. C.
Parsons, F. B.
Patterson, A. H.
Patton, E. K.
Paulson, M. T.
Paulson, T. L.
Pease, A. H.
Peck, E. F.
Peck, E. H.
Perot, L. K.
Perry, F. L.
Phipps, C. W.
Phillips, E. F.
Pinchard, W. R.
Platt, C.
Poole, C. P.
Pope, A. A.
Porter, G. F.
Potter, A. W.
Powers, S. W.
Price, C. R.
Price, C. W.
Pudge, J. T.
Purinton, A. J.
Pyle, J. E.

Ramsey, C. E.
Redman, G. A.
Reed, J. R.
Reeves, J. W.
Reidhead, F. E.
Rice, C. W.
Roberts, H. C.
Robinson, D. R.
Rosensteel, W. H.
Ross, C. A.
Ross, R. F.
Rossman, J. G.

Sachs, J.
Salisbury, B. E.
Saurman, A. B.
Sayla, A. C.
Schultz, L. R.
Scott, R. T.
Scribner, E. M.
Scribner, J.
Seely, J. A.
Shaw, A. C.
Sly, G. E.
Smith, F. E.
Smith, F. S.
Smith, H. W.
Smith, J. B.
Smith, O.
Smith, R. D.
Smith, W. M.
Smith, W. S.
Spear, A. D.
Spencer, P.
Spruance, W. C., Jr.
Stetson, G. R.
Stevens, E. H.
Stevens, F. S.
Stevenson, W. E.
Stewart, F. A.
Stieringer, L.
Storie, L.
Striker, E. H.
Swann, G. W.
Swetland, H. M.
Sadler, G. T.

Taltavall, T. R.
Tapley, W. H.
Taylor, F. H.
Terry, F. L.
Terry, A. C.
Terry, F. S.
Tibbe, A. A.
Tobey, F., Jr.
Trafford, E. W.
Trawick, I. A.
Tremaine, H. A.
Tripp, G. B.
Trump, C. E.

Upson, L. A.
Uptegraff, J. M.
Urquhart, D. F.

Von Phul, W.

Vail, J. H.
Vallee, G.

Wade, E. E.
Wagner, H. A.
Wakeman, J. M.
Walbank, W. McL.
Walbridge, G. H.
Waterman, J. H.
Wann, J. A.
Webb, H. E.
Wells, W. T.
Wendelle, G. E.
Western, B. R.
Wheeler, S. S.
Whitaker, A. M.
White, J. G.
Whiteside, W. H.
Whyte, G. S.
Whyte, R.
Wight, G. C.
Wiley, G. L.
Wilkens, C.
Wilkins, E. W.
Willcox, F. W.
Winnad, W. H.
Wolff, James
Wood, E. E.
Wood, W. A.
Woodbridge, J. E.
Wright, P.
Wyant, R. E.

Yost, H. W.
Young, A. M.
Young, E. P.
Young, H. M.
Young, J.

Zimmermann, W. F.

The following ladies were present:

Mrs. Peck, E. F.
Mrs. Candee, W. L.
Mrs. Sachs, J.
Mrs. Horer, P. H.
Mrs. Nathan, M.
Mrs. Cahoon, J. B.
Mrs. Wakeman, J. M.
Mrs. Smith, O.
Mrs. Ross, R. F.
Mrs. Neal, C. F.
Mrs. Haskins, C. D.
Mrs. Travick, S. W.
Mrs. Foster, P. B.
Mrs. Solloway, M.
Mrs. Godkin, M. L.
Mrs. Lupke, P.
Mrs. Ferguson, J.
Mrs. Harrington, M. A.
Mrs. Meek, S. G.
Mrs. De Camp, H. C.
Mrs. Hodgins, W. H.
Mrs. Hill, J. M.
Mrs. Martin, T. C.
Mrs. Kelsch, R. S.
Mrs. Smith, F. E.
Mrs. Wight, G. C.
Mrs. Low, W. W.
Mrs. Marshall, N.
Mrs. Redman, G. A.
Mrs. Johns, S. D.
Mrs. Simon, H.
Mrs. Perry, F. L.
Mrs. Dunlop, A.
Mrs. Barstow, W. S.
Mrs. Edgar, C. D.
Mrs. Patton, J. T.
Mrs. Chandler, E.
Mrs. Scribner, E. M.
Mrs. Brady, P. T.
Mrs. Phipps, C. W.
Mrs. Tapley, W. H.
Mrs. Sears.
Mrs. Insull, M. J.
Mrs. Carrick, D. A.
Mrs. Crain, S. J.
Miss Cahoon.
Miss Manson.
Miss Reed.
Miss Love.
Miss Cutter.
Miss Young, J. C.
Miss Girrier, R. H.
Miss Issertel, H. C.
Miss Jahl, A. C.
Miss Bigley, J.
Miss Alexander, W. D. B.
Miss Gilbert, F. H.
Miss Terry, C. A.
Miss Candee, M. J.
Miss Bragg, C. A.
Miss Tobey, F.
Miss Alexander, W. J.
Miss Willie.
Miss Levy.
Miss Ramsey.
Miss Daniels.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY IN CANADA.—The question of establishing communication between Halifax and Sable Island by cable, which has been under consideration by the Canadian authorities for some time, has led to a desire that wireless telegraphy be tested before the expense of laying a cable is undertaken. It is also proposed to make experiments with the wireless telegraph system between shore points and coast lighthouses with a view to determining its value in connecting points closer together than are Sable Island and the Nova Scotia mainland.

DETROIT'S MUNICIPAL STREET RAILWAYS.—The Detroit Street Railway Commission, appointed to purchase and operate for the city all the street railways within the city, has made its first for the city all the street railways within the city, has made its first report to the Common Council. The communication inditogether as to price, terms of security, franchise, and other mooted features of the proposed transactions. The commission reports, however, that it deems it prudent to defer submission of the terms of purchase to the Council and people until the suit now pending in the Supreme Court, to test the validity of the law under which the purchase is contemplated, is decided. The commission proposes, in the event of an adverse decision by the Supreme Court, to organize a corporation composed of the Commissioners themselves, to purchase the street railways under the terms now practically agreed upon, and apply to the Council for an ordinance to be in effect until the city can legally become the owner of the street railways, the ordinance and the purchase price to be submitted to the people.

GERMAN TELEPHONE SYSTEM.—Mr. Preece, of London, recently referred to the telephone system used in Germany as the very worst, from an expert point of view, of all the systems he had inspected. It is run by the government.

FRANCHISE TAXES IN HELENA.—The City Council of Henela, Mont., has adopted the report of the special committee to which was referred the matter of assessing franchises. Valuations have been placed upon electrical franchises as follows: Western Union Telegraph Company $1000; Postal Telegraph Company, $1000; Bell Telephone Company, $2000; Helena Electric Light Company, $200,000; Helena Water & Electric Power Company, $1000.

MARITIME ELECTRICAL ASSOCIATION.—The second annual convention of the Maritime Electrical Association was held at the New Victoria Hotel, Halifax, last month, and was a very successful meeting. This association comprises in its membership representatives of the leading electrical plants of Nova Scotia, New Brunswick and Cape Breton. The officers are: President, F. A. Huntress, of the Halifax Electric Tramway Company; vice-president, P. R. Colpitt, city electrician of Halifax; secretary-treasurer, R. T. Mackeen, Halifax Electric Tramway Company.

A CLOSE APPROACH TO THE ABSOLUTE ZERO OF TEMPERATURE.—Prof. Dewar, in working with considerable quantities of liquid hydrogen, corrected his former figures and found that the boiling point was only 20° above the zero of absolute temperature. With the aid of exhaustion he obtained a temperature of only 15° absolute, which, we, believe, is the closest approach to the absolute zero which has yet been attained. Unless some still lighter gas which exists in large quantities is discovered, there seems to be no means in sight for reaching the absolute zero point.

METHODS OF TRANSMITTING INTELLIGENCE.—An interesting paper by Prof. Geo. D. Shepardson in "The Year Book of the Society of Engineers, University of Minnesota," gives an account of methods of transmission of intelligence employed from biblical times to the to-day of wireless telegraphy. In the paragraphs on multiple telegraph it is stated that the duplex system dates from Gintl in 1853, the diplex from Stark in 1855, and the quadruple from Edison in 1874. It is said that one, Cushman, accidentally used a true telephone at Racine, Wis., earlier than 1851.

NEW GOVERNMENT TELEGRAPH RULE.—The Postoffice Department proposes to require all telegraph companies to furnish the original messages as vouchers when their bills are submitted for payment. This is in accordance with a decision of the Comptroller of the Treasury to this effect of which formal notice lately was given the heads of several companies which transact the government business. The Cincinnati office of one of the companies refused to deliver these messages on demand pending instructions from the officials, and to avoid further refusals Acting Postmaster General Heath promulgated in an order the Comptroller's decision.

ENGLISH HONORS FOR AMERICAN SCIENTISTS.—The Royal Institution of Great Britain, in commemmoration of its centenary, has elected as honorary members Prof. Samuel Pierpont Langley, astronomer, Secretary of the Smithsonian Institution at Washington; Prof. Albert Abraham Michelson, physicist, of Chicago; Prof. Robert Henry Thurston, mechanical engineer, Director of the Sibley College of Cornell University; Prof. J. S. Ames, of Johns Hopkins University, George Frederic Barker, physicist, Professor of Physics at the University of Pennsylvania, Philadelphia, and ex-Congressman William Lyne Wilson, President of Washington and Lee University, and formerly President of West Virginia University, and Regent of the Smithsonian Institution .

CHICAGO ELECTRICAL ASSOCIATION.—On Friday evening, May 19, the annual banquet of the Chicago Electrical Association was held at the Technical Club, Chicago, about fifty electricians and their friends being in attendance. Toasts were responded to by Mr. C. J. Warner on "Electricity of Long Ago." Mr. Warner's experience in practical work dates back more than a half-century. Prof. Carhart, of Michigan University, responded to the toast "Education," Lieut. F. B. Badt "Mathematics," and Mr. E. P. Warner to "The Construction of Electrical Generating Apparatus." Numerous informal responses were made on various topics suggested by Mr. E. W. Jewell, who acted as toastmaster. This was the 110th meeting of the association, and much credit is due to Mr. J. M. Hollister, chairman of the banquet committee, for the arrangement of the programme and the successful manner in which it was carried out.

A PROPOSED CABLE BETWEEN ICELAND AND GREENLAND.—Vice and Deputy Consul Blom at Copenhagen, Denmark, states that British fishing interests have recently petitioned the government to grant an annual subvention to the proposed cable between Iceland, Faroe Island and Greenland. The Danish government looks favorably upon the plan, but is of the opinion that it should be realized by private individuals. The Great Northern Telegraph Company, Limited, of Copenhagen, is willing to lay and work the cable, provided it is guaranteed a certain sum from the various governments and other parties interested. The royal Danish meteorological office, in Copenhagen, has issued circulars to kindred institutions throughout the world, requesting them to subscribe to daily weather bulletins from Iceland and Faroe Islands; the matter is also being seriously considered by other bodies, especially in Great Britain, and the prospects for a realization of the enterprise are promising.

A TELEPHONE COMPANY IS NOT A TELEGRAPH COMPANY.—Justice Harlan in the United States Supreme Court on May 22, announced an opinion in the case of the Southern Bell Telephone and Telegraph Company vs. the City of Richmond, appealed from the Court of Appeals for the fourth circuit. The corporation, a creature of the State of New York, authorized to do a telegraph as well as a telephone business, without obtaining previous consent, erected its poles in the streets and alleys of the city of Richmond. A controversy arising between the city and the company, the council directed that the poles be removed. Suit was brought by the company in the Federal Court for the Fourth Circuit to restrain the city from taking down the poles. The Circuit Court and Court of Appeals both decided that under the law of 1866 relative to telegraph companies the company had the right to erect its poles on all the streets and alleys of the city, and that the former could not interfere. This position, Justice Harlan said, could not be maintained. While the company's charter authorized it to do a telegraph business, the proof showed that it confined its operations to the telephone business alone, and, that being the case, the law of 1866 had no application to it. The judgments of the courts below were reversed and the case remanded for further proceedings in conformity to the decision made.

SAFETY DEVICES FOR ELECTRIC CIRCUITS.—A patent dated May 23 was issued to Messrs. Houston and Kennelly, for a device to protect low-pressure circuits from high pressures from accidental contacts, thus freeing the low-pressure circuits from danger to life and property arising from abnormally high pressures. The invention consists in connecting the low-pressure circuit to ground at one or more suitable points, through a small button, layer or prism of a chemical substance which has a high resistivity to low-pressure current, but breaks down and becomes of low resistivity when subjected to a high electric pressure, without, however, necessarily requiring the passage of disruptive discharge. Among the chemical substances that may be used are manganese dioxide, stannous chloride, lead acetate, copper bichloride, copper and ammonium, and silver sulphide. The salt is pressed into a prism or layer or button of suitably small dimensions and placed between two electrodes, one of which is connected to the ground and the other to the low-pressure circuit to be protected. Under normal pressure the material practically insulates, only a small part and almost inappreciable leakage taking place, and this only when a ground exists at some other point in the low pressure circuit. Should the low-pressure circuit become accidentally crossed with one of high pressure, the insulation of the chemical device will rapidly break down and the low-pressure circuit be thus automatically grounded through a comparatively low resistance. It is stated that a sulphide silver button one-sixteenth of an inch thick and three-eighths of an inch in diameter will permanently insulate under a pressure of approximately 50 volts.

A PROPOSED TOUR IN SWITZERLAND.—A tour is being organized by the English Institution of Electrical Engineers with the object of visiting the most important electrical works and installations in Switzerland. It will be open to all classes of members of the Institution, and, according to present arrangements, will start from London on Sept. 1. Visits will be made to the Rheinfelden power transmission works and to all the interesting manufacturing concerns in the neighborhood of Zürich, including those of the Oerlikon Company, Messrs. Brown, Boveri & Co., and Messrs. Escher, Wyss & Co. Among the other works to be visited are those of the Stansstad-Engelberg Railway, the Jungfrau Railway and the Bergdorf-Thun line. Opportunity will also be given to members to take part in the Volta celebrations at the Como Exhibition on Sept. 18, although the Swiss tour itself officially closes on Sept. 10.

A RONTGEN RAY LAMP.—A patent was issued May 23 to Andrew Plecher, of Savannah, Ga., for an apparatus for Röntgen ray illumination. An electromagnet is sealed tightly within the walls of a vacuum bulb. The winding of this electromagnet is connected to a source of high-frequency current. About the primary wire is wrapped a secondary wire in the shape of a coil all along the length of the primary as it extends from one lamp to the next, which thus forms a sort of elongated induction coil between the two coils. The cathode rays radiate from the terminals of this secondary wire, are deflected by the influence of the magnet within the bulb and bombard the specially prepared surface of the magnet core. The inner end of the magnet core bears a convex plate which is covered with a substance which flashes or shines from the bombardments of the cathode ray. The substance used is known on the market as "christaux de Sidot," made by L. M. Unkel, at Brunsweig, Germany. It is stated that the bombardment of the end of the core causes the lamp to give forth an intense illumination.

CAPACITY AND ABSORPTION IN SUBMARINE CABLES.—An interesting paper was read before the Institution of Electrical Engineers on April 27 by Mr. J. Elton Young, on "Capacity Measurement of Long Submarine Cables." The paper points out the errors which usually occur in measuring capacity by Kelvin's, Gott's and other well known methods, owing to the absorption in the dielectric of the cable itself and the different rates of absorption of the cable and testing condenser. A method originally suggested by Mr. W. J. Murphy, was then described by means of which this difficulty was overcome by an ingenious arrangement of testing apparatus. During the discussion of the paper on April 27 and May 4, Mr. Siemens put forward a theory—which meets with very little acceptance by other telegraph engineers—that the absorption of the dielectric has a very great effect on the speed at which messages can be transmitted through submarine cables, and that, *inter alia*, Messrs. Siemens' gutta percha had a much smaller absorption than any other make. Several members wished to reply to Mr. Siemens' contentions, but the chairman ruled that this was out of order, as it constituted a digression from the subject of Mr. Young's paper. The discussion has therefore been adjourned to the correspondence columns of the London *Electrician*, where Mr. Siemens' theory is being severely attacked.

ELECTRIC RAILWAY PATENTS.—On May 23 two patents relating to electric railways were granted, one to Hiram S. Maxim, of England, and the other to Robert Lundell, of New York. The former relates to a motor regulator for the multiple-unit system of electric traction, the object being to provide an automatic means of regulating the motors on the several electrically-propelled cars of a train so that each shall do only so much work as may be necessary to prevent its cars from forging ahead or lagging behind, and so pushing or pulling cars immediately in advance or in the rear. For this purpose a rod or bar or other similar form of connection is used, which extends from car to car throughout the train, and with reference to each car has normally predetermined position; and departure of the car from this position or relation will set in operation devices which will supply more current to the car motor, if its motion is retarded, or less current if its motion is accelerated. On each car is a cylinder containing a fluid, through which the above-mentioned rod extends and on which is a piston working within the cylinder through the fluid; springs acting on the rod or piston tend to maintain it in a given normal position with respect to the car; connections or gearing between the rod and the circuit-controlling devices on the car will vary the current supplied the car motor when the normal position of the rod is varied. The Lundell patent relates to improvements in the Johnson-Lundell surface-contact system of electric railway. The patent deals with means to provide a simple and efficient method for effecting the connection between the sectional service conductors and the current feeder or mains; to prevent the operative parts from being tampered with and render them secure against dangerous actions by wholly imbedding or securing them in the roadbed; and to avoid any possibility of accidentally actuating switching electromagnets through leaking or escaping currents from the current mains or the branch feeders and sectional service conductors. These objects are effected through the agency of a series of magnetically-controlled relays located in air and water-tight switch boxes imbedded in the roadbed, and adapted to control the current flow from the current feeder or main, to the branch feeders and sectional service conductors; these electromagnetic switching devices are actuated by a source of electrical energy located in a separate and independent circuit from the working circuit and preferably of low voltage, the armatures or needles of the relays being controlled in their movements by a powerful magnetic field carried beneath the car and over relays.

LETTERS TO THE EDITORS.

Wireless Telegraphy Experiments.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to your editorial comment upon the fact that no one in this country has approached the distance to which Marconi has succeeded in transmitting signals by wireless telegraphy, I would suggest that perhaps no one qualified to carry out such tests to a successful issue has felt warranted, merely for the sake of repeating Marconi's long distance experiments, in devoting the time and in incurring the large expense necessary for the construction of proper apparatus, and the erection of masts in localities corresponding to those between which Marconi has mostly carried out his experiments.

It may be pointed out that the long distance experiments thus far made in Europe have been almost entirely carried on under the auspices of different governments or companies fully qualified to meet all requirements for the tests.

WM. MAVER, JR.

NEW YORK, N. Y.

Phase Angle Measurement.

To the Editors of Electrical World and Engineer:

Sirs:—The case cited by Mr. McKay, in his communication to your issue of May 20, with reference to meters on alternating current motor circuits, seems to emphasize more the importance of proper installation of meters than to show any defects in the meters themselves. He states that one meter was connected in one leg of the motor circuit, and from this I assume that the series coil of the meter was connected in series with one wire of the three-phase circuit, and the shunt between this wire and one of the other two wires. From this it is evident that the voltage and current in the meter will not be in phase when the power factor of the circuit is equal to unity.

Thus it is possible to connect the meter so that the current in its series coil will be leading or lagging with respect to the voltage on the shunt circuit; this displacement amounting to 30 degs. with a power factor of unity on the circuit. If the meter is connected for a lagging current and there is a leading current of 30 degs. in the circuit, it will bring the current and voltage on the meter in phase, and the meter thus will indicate the total energy of the circuit; but if there is a lagging current of 30 degs. in the circuit, it is evident that the meter would stop, as it would bring the current and voltage on the meter in quadrature. If Mr. McKay had connected the shunt wire of the meter to one of the other wires of the circuit, he would have obtained about the same result as by lowering the field current of the motor.

To obtain proper registration of the energy in a three-phase circuit, two meters should be used. Even with two meters the reading would not be correct with a power factor lower than .5, unless they

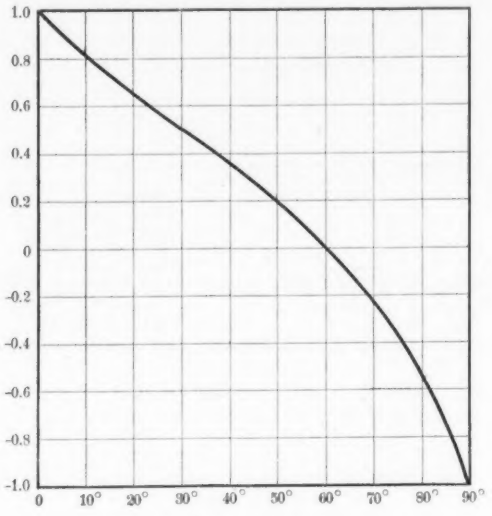
were so connected as to bring the current and voltage on them in phase when the power factor of the circuit is equal to unity. In this case, with a balanced load, one meter may be used. This result may be obtained by connecting the series coil of the meter in one of the wires of the circuit and the shunt between this wire and the middle point of an auto-transformer connected between the other two wires of the circuit. The meter will record one-half the total load of the circuit provided the power factor and load on the three phases are the same. If the load is unbalanced, two meters should be used and the sum of their readings taken.

FRANK CONRAD.

WILKINSBURG, PA.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to your editorial on phase indicators in the issue of May 13, you point out the inadvisability of using the voltmeter, ammeter and wattmeter method of obtaining the lag of the current,



PHASE ANGLE MEASUREMENT.

when the power factor is high, and you suggest the use of a voltage 90 degs. from the actual voltage to measure the wattless current. I wish to mention one method which may be used for three-phase work, which is both accurate and inexpensive. If there be an indicating wattmeter with a "star" box on the board, then there can be easily arranged two buttons or keys on the front of the board, to disconnect either of the legs of the box. Suppose the current coil in A, and call the indicated watts with C alone disconnected, and with B alone disconnected W_2. The ratio, $W_1 = W_2$, determines the power factor. For power factor of unity, $W_1 = W_2$. If the current lags when W_1 is greater than W_2, it will lead when W_1 is less than W_2. If ϕ be the angle of lag, then $\cos(30 + \phi) : \cos(30 - \phi) :: W_1 : W_2$; whence $\tan\phi = \sqrt{3}(W_1 - W_2)/(W_1 + W_2)$. If $\frac{W_1}{W_2} = R_1$, then $\tan\phi = \sqrt{3}(R-1)/(R+1)$. For values of ϕ between 0 and 60° $\phi = 60° - \frac{60°}{R}$ approximately.

In the accompanying curve, the abscissæ are degrees of lag or lead. The ordinates represent $\frac{W_2}{W_1}$ or $\frac{W_1}{W_2}$, the numerator always being less than the denominator.

If there be two wattmeters on the board, of course keys would be unnecessary. It is true that, if desired, a switch could be arranged so as to throw BC onto the voltage coil, disconnecting A from it. This connection would give practically what the editorial recommended—a voltage 90° out of phase.

Combinations of two wattmeters can be used so as to give by a direct reading, the angle of lag; the effect of the combination being merely to give the ratio of two readings. For example, imagine two Thomson wattmeters (each with its armature replaced by a thin flat coil), placed directly over each other, so that one spindle will answer for both. The two coils mounted rigidly on the spindle are placed so that their planes make a fixed horizontal angle a with each other, and the two current coils are connected in series. Let the current coil be in the A leg, and the voltage coils be connected respectively to AB and AC. The spindle will take up a position so that the forces acting on it will balance. This position will be determined by the ratio R, and hence a pointer attached to the spindle will indicate, on a suitably calibrated scale, the angle of lag. Of course, the magnets and recording devices have nothing to do with the case, the meter being used simply for illustration. If $a = 120°$, then the lag is the same as the angular deflection of the pointer. Measurements on two-phase circuits can also be made in a similar manner.

AUG. J. BOWIE, JR.

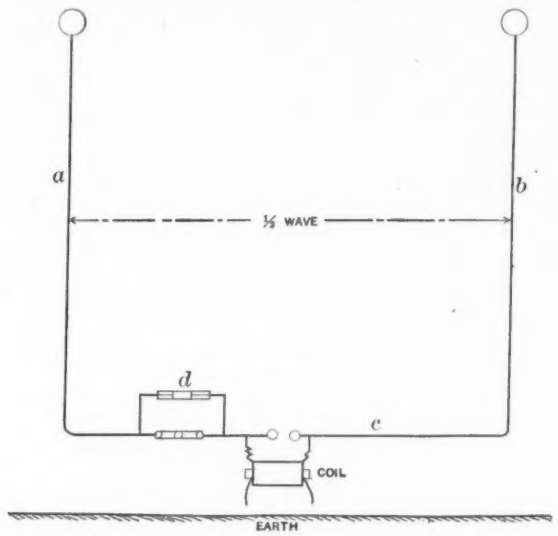
SAN FRANCISCO, CAL.

Theory of Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Referring to the letter in your last issue by Mr. Hanchett on the theory of wirless telegraphy, I may briefly express my view as follows: First. In the sending apparatus, the vertical wire radiates in all directions horizontally. The waves are electromagetic (transverse waves in the ether like light, but of low p'tch relat'vely), and at each spark, a short wave train fading rap'd'y in amplitude is emitted. The induction coil is used simply to charge the insulated vertical wire to a potential such that it may discharge to earth over the spark gap. The discharge of the wire is equivalent to a very sudden rush of current to earth along the wire, the self-induction and capacity tending to give the discharge an oscillatory character producing Hertzian waves in the surrounding ether. According to this view, the amplitude of the radiation waves will be greatest in the parts of the conducting wire and path near the earth end and least near the top. So also the addition of a ball or surface of moderate size at the top of the wire should reduce somewhat the height needed as it would tend to make the radiation more equal over the length of the wire. A double wire might be used with which no earth connection is needed. Thus, if two vertical wires, a, b, of equal height, capacity, self-induction, etc., be placed at a distance apart equal to ½ the wave length, which they, when connected at the lower end, would produce as an oscillating system, they would both radiate and enhance each others radiation in the plane of the two wires and interfere in planes at right angles thereto. We would thus secure partial control of the direction of the radiation. The spark gap in this case would be placed in the middle of the horizontal connecting wire C in accompanying sketch.

The same arrangement would act as receiver for such waves as were in synchronism with the normal oscillation rate of the system. The coherer can be placed as at d anywhere in the connection between the lower ends of the two wires.



WIRELESS TELEGRAPHY.

Second. The coherer is not the receiver of the radiation. It is merely an indicator of the fact that the circuit in which it is, is affected by absorbed electromagnetic waves. The coherer is like a supersensitive spark gap, rendered conducting upon the passage of a discharge, even for the briefest instant, of sufficient potential to break it down. The vertical wire used as a receiver, and in the circuit of which wire connected to earth the coherer is placed, is really the means for receiving the radiation and not the coherer itself. I have been at a loss to understand the apparent confusion which has existed in the minds of many people upon this point. The place of the coherer in the circuit can be varied and the coherer itself shielded from the radiation. The transverse electromagnetic waves sent out cut, in their progress outward, the vertical receiving wire and generate currents therein, of comparatively high potential

on account of the rate of cutting being very high. This is what we mean when we say that the Hertzian waves are absorbed. If the receiving wire is strictly parallel with the sending wire all parts receive at the same instant the wave in the same phase and the induced potential is a maximum. The first part of each spark discharge at the sending end is, on account of its high amplitude, the most effective in radiation and when the wave reaches the receiving wire, the maximum effect is produced so to speak by the first half wave. This explains as it appears to me, why it is that no tuning process is necessary. It shows clearly too that all our effort should be devoted to raising the potential of the sending wire before each discharge. I do not think that the ordinary induction coil is just the right thing to be used. Thus a coil, the rated spark of which is, say, 12 inches, may give only an inch or little more when connected to the earth and the vertical transmitting wire. If the fine secondary were replaced by a much heavier coil of shorter length, the charging of the vertical wire would not involve such an enormous drop in the available potential. I look to see not only a great development in the range or distance covered when all these matters are given due study and attention, but I think it may in addition be possible to direct the radiation. I do not think that the problem of synchronizing or tuning the sending and receiving systems will turn out to be so very difficult, though it may involve the giving up of the earth connection and the substitution of double vertical wires.

One may imagine a number of vertical wires set at distances apart and with the plane of each two used as a pair varied in direction, and switching arrangements combined with the connections for the lower ends of the wires so as to allow the selection of any two to be used together, as a vibrating system. It is too early to predict that such stations will be established, but there appears to be nothing impossible about it.

It is important to note here that there can be no advantage in striving after very short wave lengths for this transmission as now practiced. Too short a wave length involves more chance of disturbance of the waves and would need greater accuracy in the parallelism of the wires, so that the effect should be produced on all parts of the receiving wire in phase.

It may be interesting to mention in this connection that about ten years ago in a public lecture I made the prediction that Hertzian waves would be used in signaling, and pictured the future lighthouse as having added to its equipment of lantern and foghorn, a radiation of Hertzian waves to warn vessels during fog and storm.

ELIHU THOMSON.

LYNN, MASS.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Testing Dynamos.—Mr. Dettmar, in the *Elek. Zeit.*, May 4, criticises some of the statements made by Liebenow in his article which was abstracted in the Digest May 6. Liebenow claimed that his method is correct for large as well as slow speed machines, and in this point the present writer differs very decidedly. The friction losses in percentage value diminish for large machines, but the other losses also diminish and nearly in the same degree, so that the relation of the friction losses to the losses at no load is not appreciably changed for large machines; it is this relation between the losses which is a measure of the accuracy of the test and is affected by the assumption of inaccurate figures for the friction losses. He found that the bearing friction is proportional to the 1.5th of the power of the speed; this he intends to show in a subsequent article. The friction loss in machine varies greatly at the first start, and does not become constant until after about four and a half hours; if this is not duly considered, appreciable errors will be caused, as there may be changes in the friction within that period which are 60 and 100 per cent. of the value at the end. He claims that the proportionality obtained by Liebenow was only accidental and would not have been obtained if he had made a number of determinations. The present writer has separated out the friction losses of about 200 machines and has never found a proportional change with the speed. He does not agree that periodic testing of a dynamo is necessary, as it can only have the object to measure such losses which change and can be remedied; but this is not the case with changes in hysteresis and Foucault currents, leaving only the changes in friction and insulation; the former is noticed by the machinist by seeing that the bearings are not heating. A change in the insulation would certainly not be determined by this method.—Dettmar. *Elek. Zeit.*, May 4.

In a brief reply to this by Liebenow in the issue of May 11, he still maintains that the air friction can be neglected with less error, the heavier the armature and the slower the speed.

LIGHTS AND LIGHTING.

Alternating Current Arcs.—The paper of Messrs. Duddell and Marchant (see Digest, May 13), is continued in the Lond. *Elec.*, May 5. They discuss arcs between carbons and metals; several of the diagrams showing the curves in those cases are reproduced. These curves establish the fact that in most cases of an arc between carbon and metal, there is a complete interruption of the current in more than half the period, and this occurs when the carbon is positive, the voltage between the electrodes obtaining a high value during the stoppage of the current. Some experiments suggest that the more rapid cooling of one electrode facilitates the flow of the current from it and resists the flow toward it. Enlarging the diameter of one carbon of the usual carbon arc, has the same kind of an effect as changing the carbon for a metal. The enclosed arc is then discussed and is accompanied by a number of curves. A comparison of these shows that the effect of enclosing the arc is to produce a high peak on the voltage curve of the arc, with but a small effect on the current curve. This was very marked in the case of certain solid carbons. They had previously found that the front peak of the curve is due to the resistance of the gaseous column, and it therefore appears as if enclosing the arc increases the resistance of this column. The change produced by enclosing the arc, on the root-mean-square value of the voltage between its terminals for the same length and current, is very marked, the increase being no less than 65 per cent. for the cored carbon. In all cases enclosing the arc reduces the power factor and increases its stability. They also made some experiments on the direct current hissing arc; they found that a certain waviness in the curve was due to the arc hissing; in some cases they found this waviness only on one side of the zero line, showing that the arc hissed only when the current was flowing in that direction. The frequency of the oscillations in the voltage and current of the hissing arc between solid carbons, averages about 1000 per second, and they occur in such a way that the increase of current is accomplished by a decrease in voltage. They also made experiments with arcs between two solid carbons differing greatly in diameter; the two halves of the waves are not identical, the current being larger and the voltage smaller when the large carbon is positive, independently of which one is uppermost. The stability of the arc as an electrical phenomenon is greatly increased by a large impressed e. m. f., and with an alternating current arc the necessity of this e. m. f. is greatest when the instantaneous value of the current is small, so as to reduce the time during which the arc is extinguished in each period. The time of extinction is very important, as the voltage necessary to relight the arc increases rapidly with the duration of the extinction. A high voltage may be impressed by using a sufficient resistance or self-induction in series with the arc, the latter giving the greatest stability and wastes no power in itself, although it may impair the efficiency of the generator by causing the current to lag. The use of an inductive alternator or of a transformer, gives stability, and if besides this the machine or transformer has a very drooping characteristic, then sufficient stability may be obtained without the addition of outside self-induction or resistance. The reduction of the frequency lengthens the time of extinction and reduces the stability, and there is a limiting frequency below which the arc cannot be maintained, this being higher with solid than with cored carbons; high frequency currents are, however, less efficient than low ones. The effect of the nature of the carbon on the stability is very marked; arcs between solid carbons are much less suitable than between cored or solid and cored carbon. Vapors of foreign substances generally increase the conductivity of the arc dur-

ing the time of extinction unless they are present in the metallic state, and this increases the ease with which the arc relights and improves the stability. The compound of sodium or potassium is very effective and it is probable that the stability of the cored arc is largely due to this; but such materials lower the voltage at which the arc burns and a low voltage arc is generally less efficient than a high voltage one. A gain in stability this way is therefore probably accompanied by a loss of efficiency. Increasing the stability by adding resistance or self-induction in series, by changing the frequency or the nature of the carbons, either usually wastes more power in the circuit or decreases the efficiency of the alternator or the arc; thus an increase of stability by such methods may result in the decrease of efficiency as a light producer. The power factor of an arc of medium length gives an idea of its stability; with an increase of arc length the power factor improves while the stability becomes less; enclosing the arc increases the stability but reduces the power factor. They believe the best means of securing stability in practice to be the following: If the circuit supplies arcs only, use an inductive generator or transformer with a drooping characteristic; if the arcs are supplied from a constant pressure circuit use a transformer or self-induction in series with the arc; in either case use carbons as hard and as free from foreign substances as is consistent with stability, as this will increase the luminous efficiency. At the end of the paper the conslusions are summarized in twenty paragraphs; some of them have already been stated above, and among the others are the following: With high voltage solid carbons and small self-induction, the power factor is low and the arc is unstable; with high voltage solid carbons and considerable self-induction, the power factor is higher and the arc much more stable; with soft-cored carbons the power factor is nearly unity and the power factor is very stable; with one solid and one cored carbon the reaction is intermediate. The power factor with solid carbons decreases with an increase of length up to the hissing point and then increases; with cored carbons the power factor is generally higher for longer arcs; lowering the frequency increases the reaction, reduces the power factor and the stability, but improves the efficiency; enclosing the arc raises the root-mean-square value of the voltage and reduces the power factor; the reaction of the arc still occurs when the arc is only a part of the load on the alternator; the reaction is more marked with arcs in series; with arcs between unequal carbons the current is larger when the large carbon is positive. In all questions relating to the alternating arc, the distortions of the wave forms by the arc must be taken into account, as they considerably affect the efficiency, stability and power factor.—Duddell and Marchant. Lond. *Elec.*, May 5.

The paper, as also the recent one by Mrs. Ayrton, are discussed in a long editorial in the Lond. *Elec.*, May 12; it is chiefly in the nature of an abstract. Both papers are very highly praised. It is thought that a careful study of the completely enclosed arc would help to extend our knowledge of the essential character of the general phenomenon.

An abstract of the discussion is published in the Lond. *Elec. Rev.*, May 5, and *Elec.*, May 12. It contains nothing of special value. Most of the speakers praised the paper very highly and pointed out the great advantage of the oscillograph over the former point by point determination of such curves.

Analogy Between the Arc and Metallic Oxides.—In an article by Messrs. Burnie and Lee, in the Lond. *Elec.*, May 12, they give the results of an investigation showing an interesting conductivity analogy between the electric arc and certain metallic oxides; the latter have a high resistance at ordinary temperature but become good conductors when heated. There are certain differences between the metallic oxides and the arc, which point the way to a considerable saving in power by the metallic oxide lamps, like the Nernst. The paper consists chiefly of a description of a series of experiments. Many of the oxides have what may be termed a negative resistance, that is, for certain values of the current, an increase of the current is accompanied by a decrease of the voltage and the reverse. Their experiments were made chiefly with cobalto-cobaltic oxide. They showed that there is no large back e. m. f. and that the negative resistance is merely due to large changes of resistance caused by changes of temperature. They deduce the conditions by the differential calculus, based on the relation between the watts radiated and the resistance, and find that for a negative resistance the resistance must either increase or decrease very rapidly in relation to the watts radiated. They then endeavor to investigate whether the negative resistance is due to a varying back e. m. f. or merely due to actual changes of resistance, and for this they used the method of superposing on the continuous current a small alternating current and determining certain points on the voltage and current curves. This indicated that the observed voltage is not composed of a back e. m. f. except to a very small extent. They find that such a resistance is a conductor which merely through resistance temperature variations, exhibits nearly all the conductivity phenomena of the arc, and they believe that it is likely that with much higher frequency the arc might be shown to be a simple resistance. There is an important commercial consideration, namely, that the equilibrium of the current being unstable, requires that some method be used for keeping the current constant in the conducting oxide; Swinburne in his paper on the Nernst lamp mentioned that a resistance must be put into series with the lamp, but whether the energy loss therein was included in the 1.5 watts per candle or not, was not stated. With an alternating current, however, a choking coil could be used which wastes very little power.—Burnie and Lee. Lond. *Elec.*, May 12.

Nernst Lamp.—A brief report of a recent lecture by Nernst is published in the *Elek. Anz.*, May 11. Externally the lamp is quite like the usual incandescent lamp, except that the glass bulb has openings in it. The light is quite similar to sunlight, that is, a little yellowish compared to the bluish arc light and white as compared with the yellow incandescent lamp. The preheating is accomplished in part by a platinum spiral wound on the porcelain tube, the spiral being automatically cut out of circuit by a previously described apparatus in the base of the lamp. The preheating requires 20 to 40 seconds, according to the candle-power of the lamp. For 1-hp, 480 candles can be produced. The continuous current is quite as good as the alternating. The life of the incandescent body is about 300 hours and a replacing of the used up part is not much more expensive than with the usual incandescent lamp; definite prices are not given. At present lamps of 25, 50 and 100 candles for 110 and 220 volts are to be made. The factory in Germany is to be completed during the summer. The company now believes that this will be an important competitor with the usual incandescent lamp; the lamp takes a place between the incandescent and the arc lamp. About twenty patents have been applied for. The present note which contains practically no further information, ends by saying that the electrolytic lamp now has an undoubted future.—*Elek. Anz.*, May 11.

The new lamps were also exhibited by Mr. Swinburne at the Royal Society in London, a brief reference to which is given in the Lond. *Elec. Rev.*, May 12. The 20-cp lamp looks exactly like the ordinary filament lamp, but the bulb is used only to soften or diffuse the light. The refractory rod is about three-quarters of an inch in length and about the thickness of the lead in a pencil. The ends are attached to platinum wires, and it is also surrounded by a small cage of platinum wires with which the preliminary heating is accomplished. It is claimed that this gives one candle per 1.5 watts with a life of 500 hours, and that with two watts per candle the life is eternal. A small solenoid in the socket of the lamp cuts out the platinum heater when the lamp has been lighted. The base is made to fit the ordinary fittings Editorially it is thought that the first cost owing to the large amount of platinum used, must be considerable.—Lond. *Elec. Rev.*, May 12.

TRACTION.

Electric Locomotives.—A long abstract of what appears to have been a very long paper by McMahon containing a large amount of data, is begun in the Lond. *Elec. Rev.*, May 12; it was read before the Institution of Electrical Engineers. The paper is based on figures obtained during a period of over two years, from the daily work on the City and South London Railway, and gives the results of tests made with a number of locomotives of different types. In that underground railway, locomotives are used, usually drawing three cars; each locomotive has two motors connected in series and regulation is effected "by a reversing switch changing the armature connections, a simple rheostat and a make and break switch." The first part of the paper is on the effect which varying the starting current has upon the acceleration. It was found that the amount of the starting current had but little effect, within wide limits, on the time taken to run a section, or on the total energy drawn from the line, the motor being of the series type with plain series regulation. In the first series the starting current was limited to 100 amperes, then 120, 140, 160 and 180, the current being maintained steadily until cut down by the back e. m. f.; the velocities were respectively 13, 14, 14.5, 14 and 14.75 miles per hour, and the times taken for acquiring these speeds were 60, 50, 45, 40 and 45 seconds. The total energy consumed per trip seems to be independent of the starting current, which is contrary to American experience and seems to show that the

sections and speeds are not as well proportioned to secure economy as they might be. American practice is rapid acceleration and free running beyond a given point, and in his tests he was forced to the same conclusions, finding a decided economy in so varying the winding of the armature to give more rapid acceleration. Much depends on the length of the section and the permissible acceleration and "deceleration." The tractive effort in this tunnel in which the cars fit rather closely, was found to be for a level and a train of 37 tons at 15.86 miles per hour, 10.95 pounds per ton for a three-car train. At start it was nearly 40 pounds per ton, while at six miles per hour it was 10 pounds. Above 13 miles the curve rises again almost in a straight line and attains 22 pounds at 26.5 miles. The resistance added by a curve of 390 ft. radius was 15.15 pounds per ton at 16.5 miles per hour, or considerably more than on a straight level track; for a curve of 540 ft. radius at 13.5 miles, 11.3 pounds per ton were added, which is exactly that on a straight level track at the same speed. Roughly, a curve doubles the resistance of a train when drawn by a locomotive; in this case the wheels are pulled toward the inside rail while with a self-propelled vehicle the tendency is to press on the outer rails. Considerable data are then given concerning the starting, running, efficiency, power, etc., of different locomotives, and the effects of changing the winding of the armature. Some of the motors were rewound to give a higher tractive effort per ampere in order to solve the starting difficulty and the series parallel control was tried for the running period, although the existing switch arrangements gave very good results at small costs for repairs. Among other things he states that a train running at 20 miles per hour can be brought to rest in 20 seconds without inconvenience to passengers; with a constant deceleration force this requires a distance of 292 feet. Figures are given showing that a high starting current and high acceleration are a decided advantage. Data are given showing the performance of the armature when rewound with a large number of conductors. Good results were also obtained by lengthening the armature and magnet coils 50 per cent. He then begins to discuss the best conditions, assuming the average distance between stations to be 2700 ft.—McMahon. Lond. *Elec. Rev.*, May 12.

Long Island Railway Extension to Manhattan Island.—*Eng. News*, May 18, contains an illustrated description of the proposed extension of the Long Island R. R. under the East River, to Manhattan Island. It is said to be one of the most comprehensive and costly railway schemes projected anywhere in the United States; it will provide an all-rail route for high speed service from the Long Island suburbs to the business centres. There are said to be excellent prospects for the early construction of this extension. Electricity will be used for traction through the tunnels, and a change will be made to steam trains at Flatbush Avenue, Brooklyn. Editorially it is thought that it cannot be hoped for some time yet that the railroad will feel warranted in changing any great portion of its present steam lines to electric lines, but it is thought that such a change will partially take place as time goes on, and that in the course of time the electrical installation already begun will be extended to include other branch lines until a very considerable mileage of the western portion of the road nearest the city will be electrically operated.—*Eng. News*, May 18.

Accumulator Traction.—The *Railway World* 7, p. 304 reprints a report to the Permanent International Tramways Union, by Loenen-Martinet, a brief abstract of which is given in *Science Abstracts*, April; he reviews the present position of accumulator traction. At Hanover the plates are estimated to last 35,000 to 45,000 car-km, and in Dresden 20,000 to 23,000, the latter being equivalent to two and two and a half years. There are 105 cars in regular use in Hanover and 40 in reserve; a reserve of 10 per cent. is considered sufficient to allow for overhauling the batteries. After running 10,000-km, the batteries are cleaned without removal from the car, and plates are replaced if necessary, an operation which takes two days. To clean and repair the batteries reqires a staff of 25 men, and the cost per car per year is about $173. At Dresden the batteries are cleaned every six months and the maintenance is guaranteed at a certain figure; the repairs are said to cost from 0.7 to about 1 cent per car-km, but that is probably too low.—Loenen-Martinet. *Railway World* 7, p. 304; abstracted briefly in *Science Abstracts*, April.

Mining Traction Plant.—A brief description of the plant in the Keeling mine at Pittsburg is given in the *Eng. News*, May 18. There are two locomotives weighing about 25,000 pounds, each having two motors of 50-hp; there are seven miles of track and each locomotive hauls a train of 30 cars weighing 60 tons up a maximum grade of 1 per cent. at a speed of about 8 miles an hour. Of the 25,000 pounds on the driving wheels, 15 per cent. is exerted at the drawbar; the pull on a good level track is 10 pounds per ton for the locomotive and 18 to 20 pounds for the cars.—*Eng. News*, May 18.

REFERENCES.

Accumulator Traction.—A reprint of the paper abstracted in the Digest last week.—Sieg. *Elek. Zeit.*, May 11.

Electric Traction.—A reprint of the author's recent Society of Arts paper on electric traction and its application to suburban and metropolitan railways.—Dawson. *Sc. Am. Sup.*, May 13.

Automobiles.—Illustrated descriptions of various forms of electric and other automobiles, and a number of articles on the subject of automobiles in general.—*Sc. Am.*, May 13.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

500-Volt 3-Wire Installation.—A correspondent to *L'Elec.*, May 13, from Italy, states that last year a central station was installed in the city of Arenzano, in Italy, in which the three-wire direct-current system with 500 volts between the outer wires is used; that is, the incandescent lamps are for 250 volts; so far no objections have been found to this unusually high voltage; the anonymous writer even believes that the voltage could be increased still more. Such a plan is of special advantage for the utilization of water falls within a radius of one to one and a half miles, without great losses or an excessive cost of the feeders, and it enables accumulators to be used in such an installation, which becomes very important when an accumulation of energy is necessary; for the alternating current the use of accumulators makes a converter station a necessity, and this makes the whole installation more complicated and expensive, both in the first cost and the operation. No further information is given in the short note.—*L'Elec.*, May 13.

REFERENCES.

Municipal Plant for San Francisco.—An estimate for a municipal electric lighting plant for San Francisco having a capacity of 1537 lights.—*Eng. News*, May 25.

WIRES, WIRING AND CONDUITS.

Aluminum as a Conductor.—In referring to the substitution of aluminum for copper, an editorial in the *Eng. and Min. Jour.*, May 20, states that considering the relative conductivity, tensile strength and weight, aluminum is at present prices the cheaper metal of the two, and for many purposes in electrical work its use in place of copper is quite practicable. But that the substitution will be made to any considerable extent is not thought probable, or even possible, on the ground that the supply of aluminum is not large enough.—*Eng. and Min. Jour.*, May 20.

ELECTRO-PHYSICS AND MAGNETISM.

Terrestrial Magnetism.—*Terres. Mag.* for March contains an article by Hayford discussing the question whether there is a 428-day period in terrestrial magnetism corresponding with a similar period for terrestrial altitudes. The earth is subjected to periodic stresses which repeat their various phases every 428 days, and he suggests there may be a corresponding variation in the magnetism produced by these stresses. He examined records of observations and concludes that if there is such a period in terrestrial magnetism much more careful observations than those now obtainable are needed for detecting it with certainty.

The same issue also contains a long paper with charts, by Bauer, on the decomposition of the earth's field, in which he resolves the permanent field into component ones which are physically interpretable; it is accompanied by tables and charts. This paper was noticed in the Digest May 13. The same issue contains a short paper by Bauer in which he discusses the question of whether the source of the secular variations of the earth's magnetism are within or without the earth's crust; he believes that the causes are within the crust of the earth.

The same issue contains a short review of observations of the earth's magnetism in the northwest of Greenland by Stade. Also an abstract by Geitel of a paper by Travert on the relation between a phenomenon of the earth's magnetism and the electrical phenomenon of the atmosphere. Also a short discussion on the theory of the compass deviations by Davies. Also an abstract of a paper on a plant for a magnetic observatory by Wild. Several other papers are noticed in the Digest under separate headings.—*Terres. Mag.*, March.

REFERENCES.

Magnetization Induced by the Earth's Field.—A short article, in French, in which he discusses mathematically the magnetization in-

duced in a magnet by the earth's field. He determined a correction factor to be applied to cases in which measurements are made by means of the earth's magnetism.—Mascart. *Terres. Mag.*, March.

Electricity of Atmospheric Deposits.—A paper on the electrification carried by the moisture, etc., deposited from the atmosphere.—Elster and Geitel. *Terres. Mag.*, March.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrical Energy from Carbon.—The Lond. *Elec. Rev.*, May 12, contains a short article by Tommasi on a battery recently attributed to others which he said he devised fifteen years ago. The soluble or negative electrode instead of being metal, consists of carbon in salted or acidulated water; the other pole consists of carbon covered with a thick layer of peroxide of lead; the e. m. f. is 0.6 to 0.7 volt; the battery polarizes rapidly and is only suitable for closed circuit work and for intermittent currents. The carbon decomposes the water, forming carbonic acid and hydrogen. The theory is given.—Tommasi. Lond. *Elec. Rev.*, May 12.

Production of Crystallized Tungsten.—In the *Comptes Rendus*, Mr. Hallopeau describes the electrolytic production of crystallized tungsten, a brief abstract of which is given in *Science Abstracts*, March. Lithium paratungstate fused at about 1000° C. is electrolyzed between platinum electrodes and after extracting the mass with water, hydrochloric acid and a solution of lithia, a residue of the tungsten remains which contains a little of the platinum derived from the electrodes.—*Comptes Rendus*, 127, p. 755.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Vibration of Apparatus.—Mr. Broca, in the *Jour. de Physique*, 7, p. 648, abstracted briefly in *Science Abstracts*, April, describes briefly experiments to find how far a sensitive apparatus placed on rubber blocks is protected from vibrations. He found that if the apparatus is of a rigid type and has no movable parts with natural periods of the order of one second, the rubber blocks afford perfect protection against vibration. But if the apparatus has a movable system like a galvanometer, the vibrations are increased instead of diminished, the rubber serving as a support on which the apparatus vibrates with a much longer period; it influences the movable system much more than when the period of vibration is short.—*Science Abstracts*, April.

REFERENCES.

Capacity Measurement of Long Submarine Cables.—The conclusion of Young's paper (see Digest last week) and the discussions are concluded in the Lond. *Elec.*, *Elec. Rev.*, and *Elec. Eng.*, May 12. In the Lond. *Elec. Rev.* there is also a reprint of a contributed discussion by Murphy, pointing out the difference between Young's method and that of Gott. He praises Young's paper very highly.

Electrostatic Voltmeter.—A description of one designed as a standard, of the attracted disc type; it will measure 20 to 70 volts with an accuracy of 0.1 volt.—Perot and Fabrey. *Jour. de Physique* 7, p. 650; abstracted briefly in *Science Abstracts*, April.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Pacific Cable.—The official report of the Pacific Cable Committee, which was briefly referred to in the Digest last week, is discussed editorially at some length in the Lond. *Elec.*, May 12, the discussion being, in general, unfavorable. The main argument in the criticism seems to be that it is a waste of money for the government to do what can be done better by private enterprise; the argument is not against the Pacific cable itself, as many of the objections raised would lose much of their force if the lines were laid as an adjunct to the present system, instead of in competition with it. It is thought that the greatest speed over the longest section cannot be more than three or four paying words per minute. It is too much to assume that the new line would attract even a fourth of the present traffic. There is a great necessity also of a duplicate cable laid at the same time. It is thought that the difficulties would be considerably reduced by using the route from San Francisco to Honolulu, in view of the friendly relations existing between England and the United States; this, however, would not suit Canada. That cables land on British territory is no protection to them in time of war. It is also questioned whether the world's supply of gutta percha would suffice for both this and the Cape scheme, and the price would be greatly increased. It is also thought that the committee has not adequately grasped the difficulties involved in the laying, maintaining and working of the cable.—Lond. *Elec.*, May 12.

This is followed by extracts from the correspondence with the colonies on this subject; in which the conditions are named under which the government has offered an annual subsidy. These are also given in th Lond. *Elec. Eng.*

The Lond. *Elec. Rev.*, May 12, criticises very unfavorably the statement made by its contemporaries (see Digest last week) that 10 per cent. slack in this cable is not enuogh. The report itself quotes representatives of various cable laying companies to the effect that this is suffcient.

Wireless Telegraphy.—A brief editorial reference in the Lond. *Elec. Rev.* May 12. It is stated that Marconi has succeeded in concentrating electric waves for a distance of three miles by reflectors, but has found them ineffective beyond that distance. He does not rely on syntony, which has been shown experimentally not to exist with an earth connected system. Lodge's system, which has no earth connection, is of the kind required for successful syntony. Syntony would be a very poor protection against overhearing, as the frequency of any receiver could easily be changed until the message was picked up.—Lond. *Elec. Rev.*, May 12.

REFERENCES.

Etheric Telegraphy.—A reprint of a short Society of Arts paper referring to his early experiments and to the present system of Marcent. slack in this cable is not enough. The report itself quotes rep-*Elec. Eng.*, May 12.

Wireless Telegraphy.—An illustrated description of the Ducretet (French) apparatus.—*Sc. Am. Sup*, May 13.

Train Signalling.—A short article on the relative importance of train signalling.—Pigg. Lond. *Elec. Eng.*, May 5.

Rewinding the Hughes Apparatus.—An illustration of an automatic method.—*L'Eclairage Elec.*, May 6.

MISCELLANEOUS.

REFERENCES.

Institution Meeting in Switzerland.—A reprint of the provisional programme for the reunion of the British Institution of Electrical Engineers, which is to be held in Switzerland in September.—Lond. *Elec. Eng.*, May 12.

Biographical.—The biographical sketch of the late Gustav Wiedemann.—Foeppl. *Elek. Zeit.*, May 11.

New Books.

LIQUID AIR AND THE LIQUEFACTION OF GASES. By T. O'Connor Sloane, Ph. D. New York: Norman W. Henley & Co. 365 pages, illustrated. Price, $2.50.

The book is devoted to semi-popular account of the theory and history of liquefied gases, with particular reference to liquefied air. There are seventeen chapters, the first four of which are devoted to the elementary theory of the subject, the succeeding eight chapters to the work of the Royal Institution, Michael Faraday, early experimenters, Raoul Pictet, Cailletet, Wroblewiki and Olszewski, Dewar and Tripler, respectively. The last five chapters are devoted to the applications of liquid air and various types of apparatus utilizing or producing it. A copious index concludes the book.

The book is of considerable interest to the general reader in the development of liquid air, and to the elementary student. It is clearly and interestingly written. No unreasonable expectations are indulged in concerning the capabilities of liquid air as a source of power, although some unreasonable speculations seem to be indulged in concerning the use of liquid air as an electric insulator.

Correction.—In the review of Waddell's "Arithmetic of Chemistry" in the issue of last week, page 718, 2 $HgO = 2\ HgO_2$ should be $2\ HgO = 2\ Hg + O_2$. The O of HgO should not have been italicized, italics in the author's system being only used for gases existing as such.

BOOKS RECEIVED.

REGELUNG DER MOTOREN ELEKTRISCHER BAHNEN. By Dr. Gustav Rasch. Berlin: Julius Springer. 150 pages, 28 diagrams. Price, 4 marks.

ELEKTROMOTOREN FUR GLEICHSTROM. By G. Roessler. Berlin: Julius Springer. 140 pages, 49 diagrams. Price, 4 marks.

MECHANICAL MOVEMENTS, DEVICES AND APPLIANCES. By Gardner D. Hiscox, M. E. New York: Norman W. Henley & Co. 402 pages, 1649 illustrations. Price, $3.00.

The Ball & Wood Engine.

The Ball & Wood Company, 120 Liberty Street, New York, exhibits a working 300-hp tandem compound engine with cylinders 16 x 26 x 16. This engine is fitted with Corliss valves and is of the high-speed type, running at 250 revolutions per minute. It is to be direct connected to two 100-kw General Electric generators, one generator on each side of the crank shaft. The generators, however, have not yet reached the Garden, so the engine is at the present time simply turning over without doing any work. It is of the self-oiling type and fitted with a standard Ball & Wood governor. The shaft has four bearings, two on the engine bed and two outboard. The engine cuts off at about one-quarter stroke, and its variations in speed from full load to no load is about 1 per cent. Messrs. Hews and H. E. Mead are in charge of the exhibit.

Exhibit of Non-Arcing Fuses.

H. W. Johns Manufacturing Company and The J. Jones & Son Company have a joint exhibit on the northern end of Newspaper Row, very tastefully and effectively arranged. It consists essentially of the Sachs "Noark" fuse, designed by Mr. Joseph Sachs, and now being placed on the market. A number of switchboards and panel boards are shown equipped with these fuses, and a constant demonstration is made as to the blowing of open and enclosed fuses. The fuse has the special and peculiarly valuable feature that while it does not arc it indicates at all times the condition of things so that the state of the circuit is known.

The switchboards and panels shown are furnished by the J. Jones & Son Company, and comprise also their special fittings, such as their automatic cut-out clocks, and their cut-outs for 220, 500 and 2500-volt construction. Taken altogether, the exhibit is one of the most novel and useful in the garden. There are distributed from the exhibit special literature and a "Noark" souvenir in cardboard.

The Stirling Boiler Exhibit.

The exhibit of the Stirling Company, of Chicago, Ill., is probably the largest individual piece in the entire hall. It consists of one 150-hp water-tube boiler erected in position. The boiler stands 15 feet 2 inches high, is 14 feet 9 inches long and 8 feet wide. The boiler consists of three upper or steam drums and one lower or mud drum, connected together by tubes, each bent slightly so as to allow them to enter the drums. The steam spaces of all the upper drums are connected, while the water spaces of only the front or middle drums communicate. The drums are made of the very best flanged steel, while the tubes are either lap-welded mild steel or charcoal iron tested at 1500 pounds per square inch. No cast metal is used in the construction. A fire brick arch over the grates promotes combustion and directs the flame against the tubes. The gases have a long and circuitous passage and come in contact with the tubes, which insures an exhaustive delivery of their heat to the water and tends to the very highest economy attainable. The company also shows a turbine tube cleaner of the Chicago Boiler Tube Cleaner Company. This device is attached to a pressure hose, the escaping water causing a small turbine in the head of the machine to rotate. To the turbine is connected, by means of a universal joint, four movable arms, which are expanded radially by centrifugal force, in their rapid rotation. To the ends of these fingers or arms are a series of star cutting wheels which cut the scale. The escaping water carries away the scale as it is cut from the tube. Mr. Greeley, of the New York office, is in charge of the exhibit.

Safety Wires and Cables.

The Safety Insulated Wire & Cable Company, 239 West Twenty-eighth street, New York, has a very attractive booth on the main floor. The booth is finished in white, and over the entrance is the well-known trade mark of the company, surrounded by a row of lamps. On a large sample board are shown short lengths of submarine, underground, and aerial cables. Among the samples of submarine cables are pieces of the shore end and deep-sea Manila cable, and of a three-inch telephone cable laid under the North river at New York. Of the five samples of subway cables is one made for the Metropolitan Street Railway Company for three-phase alternating-current distribution on that company's system. Each of the three conductors is made up of forty No. 10 copper wires. Among the aerial cables are a large trolley feeder of 1,500,000 circular mils area, and various sizes of telephone and telegraph cables. A very attractive feature of the exhibit is the illuminated signs. Over the cable sections above referred to are 12 square ground glass panels. At regular intervals of time each of these panels becomes illuminated, some showing illustrations of cables and cable-making machinery, and others setting forth some facts concerning the Safety Company's products. Another sign in a large frame, is illuminated by changeable colored lights—red, white and blue—displaying the name and address of the company. A similar sign is illuminated in three horizontal sections in succession, and proclaims the fact that the company is contractor to the United States government and manufacturer of high-grade insulated wires and cables for aerial, underground and submarine use. There are two smaller illuminated panels which tell interesting stories about the company's products. "The Sun Never Sets on Safety Cable" is the information given on one, together with the additional fact that the company supplied the United States government with all the cable used in the late war, in Cuba, Puerto Rico and the Philippine Islands. A small space is curtained off at one end of the booth, and fitted up as a cosy office and reception room. The ceiling of the booth is finished off in a fabric of neat design and the floor is covered with rugs, and altogether the enclosure is a very inviting and attractive resting place. Mr. A. P. Eckert, of the company, looks after its interests in the evening, and General Manager L. F. Requa drops around occasionally to meet friends and see that things move all right. Messrs. Ira W. Henry, electrician, and H. T. Richards are in constant attendance.

Exhibit of Dixon Graphite Products.

The Joseph Dixon Crucible Company, of Jersey City, N. J., has a display of graphite goods in a tastefully furnished booth on the north side of the amphitheatre. At the back is a show case containing graphite products for electrical work, including resistance rods up to 2 inches in diameter and 12 inches in length, with resistances ranging from 1 ohm to 1,000,000 ohms. The dimensions bear no particular relation to the resistance. This makes the use of graphite valuable where space is contracted and high resistance required. Where much current is to be carried sufficient radiating surface must be provided for preventing undue heating. Graphite is not affected by acids, alkalis or any known solvent, and possesses very high conductivity, making it valuable for battery plates, etc. There is also exhibited graphite for lamp cement. This cement is used in repairing incandescent lamps, and is said to be unequaled for this purpose. The Dixon Company has recently commenced the manufacture of graphite brushes, a line of which it has on exhibition. There are also shown graphite lubricants for dynamos and commutators. The exhibit is in charge of Mr. John H. Baird, of the New York office at 68 Reade Street.

THE BALL & WOOD 300-HP TANDEM COMPOUND ENGINE.

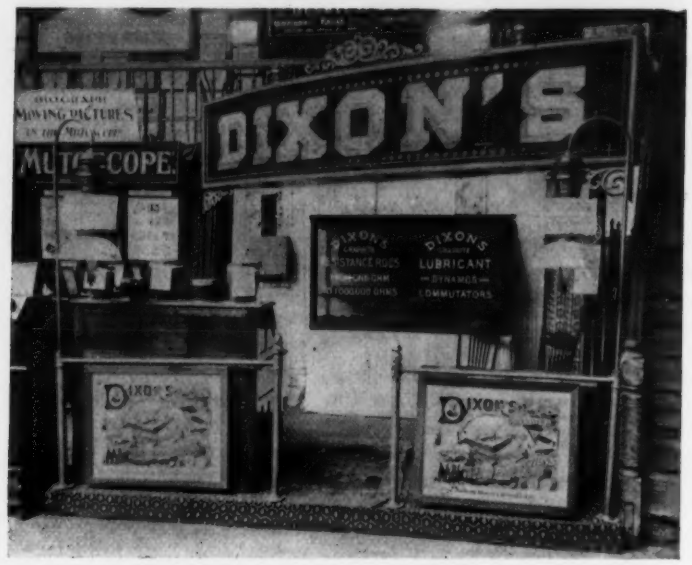
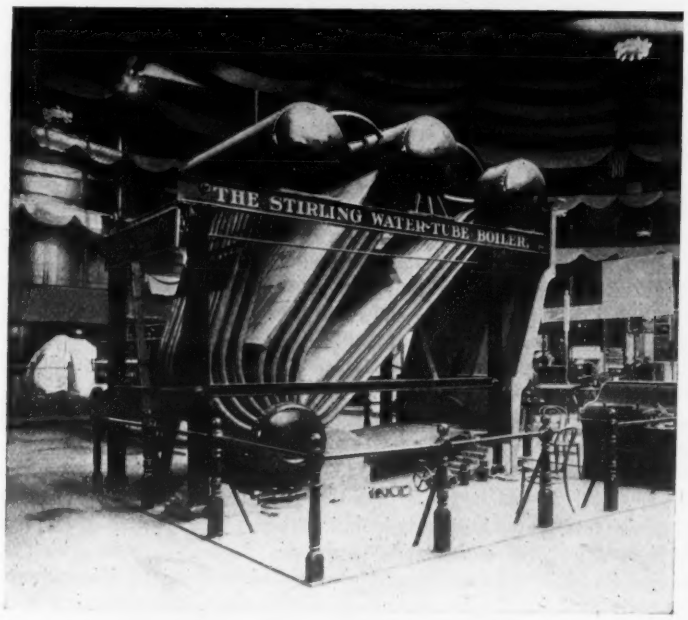


EXHIBIT OF DIXON'S GRAPHITE PRODUCTS.

THE H. W. JOHNS MFG. CO. AND J. JONES & SON CO. EXHIBIT.

THE SAFETY INSULATED WIRE & CABLE CO.'S BOOTH.



THE STIRLING WATER TUBE BOILER.

EXHIBIT OF PLATINUM GOODS.

Baker & Co.'s Platinum Exhibit.

Among the many interesting exhibits at the Electrical Show, now running in the Madison Square Garden, none perhaps attracts greater attention from the scientist, the laymen interested in useful products and the simple admirer of artistic effects, than the exhibit of platinum and its application to the arts and industries, made by Baker & Co., platinum refiners, on the northern promenade.

As the exihibt illustrates in various interesting ways, platinum is used in jewelry for ornamentation—especially in diamond settings; upon silver-ware for producing dead black effects; in artificial teeth as rivets for attachment to supports; in the electric incandescent lamp as a fine wire for conveying the electric current through the glass walls of the bulb to the light-giving carbon filament within; in telegraph, telephone and other electric apparatus as non-corroding contact points; in warfare, in the form of fine wires for exploding torpedos and submarine mines; in pyrometers, for the measurement of the temperatures of blast furnaces, and for determining the fusing point of other metals; in cauteries and surgical instruments, for the treatment of wounds where metallic poisons must be avoided; in the X-ray tube, as leading-in wires and as a source of excitation of the X-rays; in X-ray screens in the form of a salt, which renders the X-rays luminous, and in photography in the production of platinotypes noted for the artistic effects produced and the permanency of prints attained. The above are but a few of the many applications of this metal and its salts, but enough are enumerated to illustrate its wide and varied applications in ministering to man's comfort and pleasure.

In the exhibit mentioned above, an excellent opportunity is given the visitor to observe the practical uses made of this metal. In the small space of ten feet front, artistically decorated in blue and white, within a modest sized showcase, are exhibited many thousand dollars worth of platinum in the many forms given to it, between the state of crude ore, and the finished article of commerce. Samples of crude platinum sand and nuggets from all parts of the world, including the largest nugget ever found in this hemisphere, are shown in an attractive form, together with many specimens of the associated metals of this group, such as iridium, palladium, rhodium, osmoiridium, ruthenium and osmium. Grouped about, there are many samples of the salt of these metals, exhibiting a beauty and variety of color and crystalline form. There are also the samples of platinum apparatus, such as are used by chemists, dentists, jewelers, electricians and incandescent lamp manufacturers.

An interesting part of the exhibit are four cylindrical rods of pure gold, silver, platinum and aluminum of equal size, which are shown as illustrations of the relative weight and value of these metals. From the card attached, we take this data: Gold weighs 10.19 ozs., is worth $210; silver weighs 5.55 ozs., is worth $3.50; platinum weighs 11.34 ozs, is worth $196; aluminum weighs 1.37 ozs., is worth $0.09.. If one lifts first the platinum rod and then the aluminum the difference in weight is almost startling. The walls of the booth are adorned with fine illustrations of the photographic art upon platinum paper. Taken all in all, this exhibit appeals strongly to the lover of artistic display and the seeker after knowledge.

Katzenstein Packings.

Messrs. L. Katzenstein & Co., 357 West Street, New York City, have occupied a space fronting on the main aisle near the Fourth Avenue end of the building. Samples of self-acting metal packing are shown. There are also various expansion and slip joints for the purpose of illustrating the method of using this packing.

The Katzenstein flexible metal packing has been used in this country and in Europe for over nine years in different kinds of slip joint stuffing boxes on steam pipes and against hydraulic pressure.

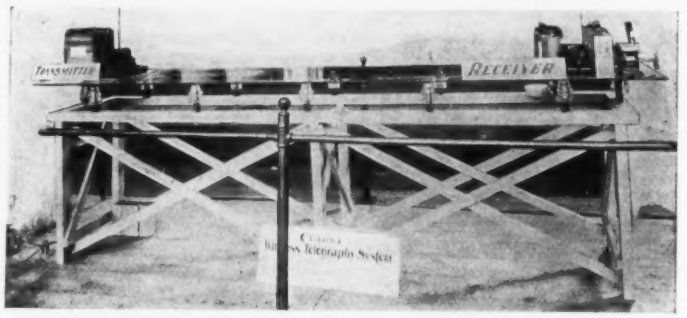
Fayerweather & Ladew Belting.

Messrs. Fayerweather & Ladew, Inc., of New York, make the only exhibit of leather belting at the Garden. Their booth is located at the Fourth Avenue end of the hall on the main floor. There are shown many rolls of belting of all sizes. There is one roll of 48-inch double extra heavy leather belting 100 feet long; one 44-inch of the same make and one 40-inch belt. There is also shown a 24-inch three-ply belt, besides various sizes of extra heavy flint and dynamo belting and round belting, both solid and twisted. This company manufactures the Hoyt oak tanned leather belting. Hanging at the back of the booth is a complete hide. Only the middle section of hides is utilized for the manufacture of belts. There are also shown various sized cans of belt cement. Mr. Griffin is in charge of the exhibits, and represents the company's interests.

Wireless Telegraphy.

The wireless system of telegraphy which is attracting much wide attention at the present time, both in this country and in Europe, is practically illustrated at the Garden by an exhibit of wireless telegraph apparatus in actual operation.

A complete sending and receiving outfit are shown. The apparatus is all set on a plate of glass about ten feet long and two feet wide. This glass lies upon ten glass telegraph insulators, the whole resting on a light frame structure. At one end of the glass plate is the transmitting apparatus, which consists of an oscillator and a Morse transmitting key on its base. The coil of the oscillator is energized by five cells of New Standard dry battery. Rising from one of the terminals of the high tension coil is a piece of copper wire 12 or 15 inches long. A similar piece of wire is connected with the receiving apparatus at the opposite end of the glass stand. The receiving instruments, all of which are on one base, include a Morse sounder, relay and coherer. The coherer is tapped by the armature of a relay, whose action coincides with the signals received. There is also a Morse register which makes a visible record of the signals. The receiving apparatus is operated by thirteen cells of dry battery. The exhibit is in charge of Mr. M. H. Kerner, who represents the manufacturers of the apparatus, the United States Electrical Supply Company, of 141 East Twenty-fifth street, New York City.



WIRELESS TELEGRAPH APPARATUS.

The A. A. Griffing Iron Company.

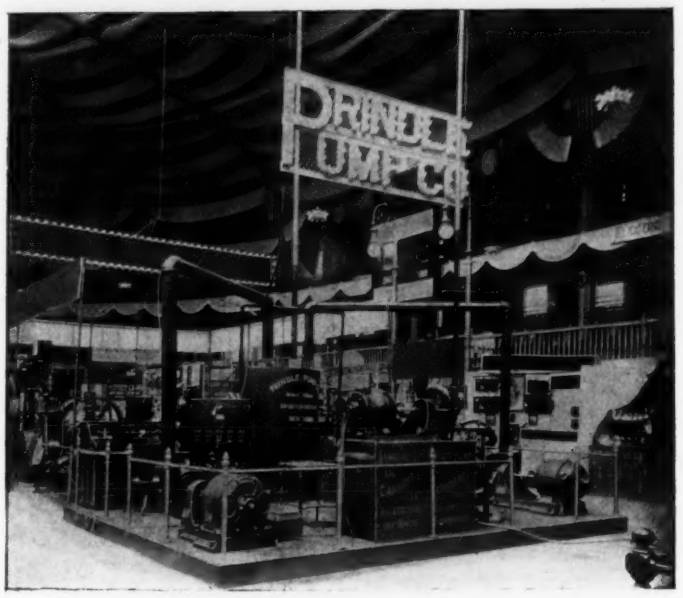
An exhibit of special interest to steam engineers is that of the A. A. Griffing Iron Company, 66 Centre Street, New York, which makes a display of its Bundy steam specialties. There is shown in practical operation a single-return trap system and a tank trap discharging water to a tank, also a Bundy duplicate return-trap system. Among the other devices shown are a 14-inch exhaust head, steam and oil separators, one of the latter being 12-inch size. These separators are made up to 24 inches. The exhibit is notable as an excellent piece of steam engineering work, and was designed by Mr. D. J. Lewis of the Griffing Company. The Bundy return steam trap will return to the boiler condensed water from all apparatus using live or exhaust steam for power, heating, drying, cooking or other purposes. It can also be used in place of a steam pump for lifting water from a low to a higher level, discharging into a tank, heater, or to the atmosphere. It will discharge against any pressure less than the pressure of the live steam operating the trap, which provides the force for elevating the water. The trap can also be used as an initial boiler feeder in place of a steam pump, receiving the water from the feed water heater and discharging it into the boiler at regular intervals, thus constituting a gravity feed apparatus which is said to be both satisfactory and economical in results. The advantages claimed for the Bundy return steam trap when returning condensation to the boiler, are: Saving of the condensation; return of

pure water to the boiler; return of hot water to the boiler; saving of latent heat units; reduction of fuel consumption and increased efficiency of the plant.

Prindle Pumps.

The Prindle Pump Company, 120 Liberty street, New York, makes an exhibit of three large centrifugal pumps, direct-connected to electric motors. One of these motors is a Lundell, of 7½-hp, which drives a 2-A pump operating against a 50-foot head and delivering 100 gallons per minute. A 10-hp Westinghouse alternating motor operates a 6-C pump delivering 1000 gallons per minute against a head of 12 feet; and a 7½-hp General Electric direct-current motor drives a 5-B Prindle centrifugal pump designed for medium lifts. The 6-C pump, which is driven by the alternating motor, is designed for low lifts. The 5-B pump operated by the General Electric motor delivers 700 gallons of water per minute against a 12-foot head. There is also exhibited a Lawrence vertical engine, direct connected to a 6-C pump. The Lundell motor which operates a 2-A pump, is started and stopped automatically by an automatic starting and stopping device manufactured by Messrs. Zimdars & Hunt, of New York City.

The switchboard used in controlling the various motors in the



THE PRINDLE PUMP EXHIBIT.

exhibit was also made by Messrs. Zimdars & Hunt. It is about three by four feet and made of marbelized slate. It contains five double switches and an automatic motor starting rheostat.

The exhibit is under the direct supervision of Mr. R. S. Prindle, who is assisted by Mr. A. S. Ives and Mr. R. E. Bruckner.

McCay Regulating Sockets.

The McCay Engineering Company, of Baltimore, Md., has an exhibit which is without a counterpart, consisting of a line of regulating sockets manufactured by this company. By the use of these sockets it is possible to turn down the light of an incandescent lamp to any degree of illumination desired, ranging from 1 to 16 candle power. On a marble board at the front of the booth are arranged in the arc of a circle eight 16-candle-power lamps, a watt meter and a switch, so arranged as to connect the watt meter to any one of the eight lamps in order that the consumption of current at any degree of illumination may be noted. The consumption on the lowest step is 10 watts, and this is increased by regular gradations to the full amount required for 16 candlepower. It is stated by Mr. H. K. McCay, who is in charge of the exhibit, that the saving in current effected by the use of this socket will pay for the cost of the socket in one year. The socket is designed for use on alternating current and is said to save current and increase the life of the lamp. No resistance is used and hence there is no waste of current, the dimming action being due to the use of reactive coils contained within the socket.

Standard Steam Specialty Company.

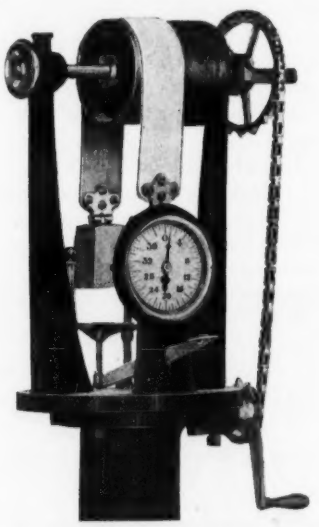
The Standard Steam Specialty Company, of the Constable Building, 111 Fifth Avenue, New York, has an extensive exhibit of steam specialties. These include a combination exhaust muffller tank, oil separator, return tank and pump governor—four devices in one. This apparatus is designed to utilize the exhaust steam from engines, removing all of the oil so that the steam can be used over again for heating purposes, and the return water of condensation is pumped back to the boilers free from oil. The tank shown at the exhibit is of the same capacity as the one used in the Judge Building in New York. There are also shown back-pressure valves, Sirius steam traps, Utility pump governors, pressure-reducing vales, etc. Mr. Herbert A. Johnson, president and treasurer of the company, is in charge of the exhibit, which is located on the main floor along the central aisle.

The Kieley & Mueller Exhibit.

Messrs. Kieley & Mueller, of New York, make an exhibit on the main floor, of their improved Climax damper regulator in practical operation; pump governors, steam traps, steam and water reducing valves, noiseless back pressure valves, water arches and oil supporters. A sign calls attention to the fact that about 100 of this firm's steam traps are used in Dewey's fleet in the Philippines. There is also shown a temperature controller for hot water tanks. Messrs. Kieley & Mueller manufacture a large line of steam specialties used by many of the foremost engineers for all modern power and heating systems.

The Rockwood Manufacturing Company.

An exhibit which is attracting its share of attention from those interested in power transmission is that of the Rockwood Manufacturing Company, Indianapolis, Ind. The exhibit consists of paper pulleys, paper polishing wheels, paper frictions and devices, showing some of the applications of friction transmission. An object of interest in the booth is a testing device which shows the relative values of paper and iron pulleys for belt transmission. By referring to the



TESTING DEVICE FOR BELT PULLEYS.

illustration shown the plan of operation will be readily seen. The device consists of a dial scale graduated in pounds, a paper and iron pulley on a horizontal shaft, a belt connected with the scale and a weight which keeps a constant tension on the belt. The test shows that the adhesive power of the iron pulley is 3 pounds, while that of the paper pulley is 12 pounds. Paper pulleys are guaranteed to carry loads with one-fourth the tension that would be necessary if iron pulleys were used. There is also shown in this exhibit a pulley 20 inches in diameter, 12-inch face, which has been in use in the power plant of the Indianapolis Light & Power Company at Indianapolis for fourteen years, which to all appearance is in as good condition for service as the new pulleys shown.

Riker Brougham at the Show.

During the first two weeks of the exhibition, a great feature of attraction among the automobiles was the superb brougham in the Riker exhibit. It is now being shipped away under imperative instructions from the owner in Paris. It was built from very rigorous specifications and on original designs furnished from France. The brougham has a weight of 4000 pounds complete, and will carry two passengers in addition to the operator and a footman or attendant. It is equipped with two motors of 3-kw each, and its battery permits a total of 25 miles on level macadam at each charge, and a maximum speed of 10 miles an hour. The indications as to the condition of the battery are given by a combination voltmeter and ammeter. The controller gives three speeds ahead and two to the rear. The brougham has a wheel base of 80 inches and a tread of 59 inches. It is fitted with solid tires, 2 inches, by 36 in front and 42 inches in the rear. The driving is effected from the rear wheels and the steering by the front wheels. There are handsome electric side lights and the carriage is upholstered in dark cloth, the interior being fitted with speaking tube, racks, clock, etc., all of an ultra fashionable style. But, what is more than mere beauty of appearance, the brougham has a smoothness and ease of motion that attest markedly the excellence of design.

Northern Engineering Company.

The exhibit of the Northern Engineering Company occupies a prominent position on the main floor and consists of a very comprehensive display of the apparatus of various concerns represented by this company, whose headquarters are at 39-41 Cortlandt street, New York.

It includes a Fischer 75-hp engine running at the rate of 275 revolutions per minute. The most important feature of this engine is the double valve which it is claimed has a Corliss distribution of steam and Corliss economy. Another feature of the engine is the self-oiling device. The oil supply is in a tank, the oil being picked up by chains passing over the shaft and down just below the surface of the oil where the lubricant is clean and free from any impurities. Another feature of the engine is the partition plate and stuffing box which prevents condensation from getting into the oil chamber and vice versa, the oil from reaching the cylinder.

Another feature of the engine is the throttle valve, which is quick acting. This engine drives two Warren-Medbery inductor alternators belted in tandem to the engine pulley. The smaller of the two alternators is a multivoltage machine, with two circuits. The two center wires carry 110 volts and the two outside wires 1100 volts. The former voltage is used for lighting and the higher for long distance transmission.

The second alternator is a two-phase machine and is used for power. Both machines are excited by Triumph Electric Company's exciters. The capacity of the smaller alternator is 60-kw at 1000 volts, with a frequency of 133 cycles, while that of the larger is 75-kw. with 2000 volts, 60 cycles.

The Northern Engineering Company's exhibit also includes a 20-kw Northern dynamo, direct-connected to a Buffalo Forge engine. This outfit runs the two 10-hp motors of the Prindle Pump Company's exhibit. There is also shown a 20-hp motor belted to a Brush arc dynamo which supplies current for the Adams-Bagnall Company's exhibit, and also runs the Crocker-Wheeler Company's signs of 350 lights, the American Electric Vehicle Company's sign of 100 lights, and charges the storage batteries of the electric vehicles of the Fischer Equipment Company.

There is also shown a Buffalo Forge Company's vertical engine, direct-connected to the 10-kw Northern dynamo. The exhibit also includes a couple of automatic elevator starters made by the Electrical Appliance Company of Jersey City, N. J. The two switchboards used in controlling the various devices operated from the generators in this exhibit were manufactured by the Crouse-Hinds Electric Company, of Syracuse, N. Y., and by the Warren-Merbery Company, of Sandy Hill, N. J. The Crouse-Hinds Company board is for the direct current service and is very attractive and substantially constructed. It has an all-metal frame and the posts of the switches are silver-plated. The alternating board made by the Warren-Medbery Company is of that concern's standard type. It has two panels, one for the two-phase service and the other for the single-phase, and is equipped with standard switchboard instruments. The Northern Company also exhibits a Westinghouse 2000-volt converter which reduces the pressure from the larger Warren inductor alternator to 200 volts for the operation of the alternating current motor in the Prindle exhibit.

The exhibit was installed by the Norden Electric Company, of New York. The Northern Engineering Company is the New York agent for the Northern Electrical Manufacturing Company, of Madison, Wis.; Electrical Appliance Company, of Sandy Hill, N. Y.; Buffalo Forge Company, of Buffalo, N. Y.; and the Fischer Foundry & Machine Company, of Pittsburg, Pa. Above the exhibit space is a sign lighted by 180 16-cp lamps.

The Bryan-Marsh Company's Exhibit.

One of the most attractive spaces on the main floor is that of the Bryan-Marsh Company. It is located on the center aisle and is one of the most tastefully arranged enclosures in the entire hall. On a partition at the back of the booth are antique medallions and panels and other representations of classic art. In the center of the space is a circular settee handsomely upholstered. In designing this booth Mr. Marsh displayed excellent artistic taste. The company's commercial interests are represented by a handsome sign at the back of the booth, displaying the name of the company in plain "Imperial" lamps set against block letters on an olive background and faced with gold leaf. The effect at night of the clear light against the gold is extremely brilliant and effective. The rear wall of the booth is covered with Turkey red fabric, and the floor is covered with a cloth of like color, surrounded by an olive border. A neat railing encloses the space. At the front of the space is seen a very prosaic piece of apparatus which looks like a long, plain wooden box set on wooden horses. Its outside appearance, however, to the uninitiated, does not indicate its nature and utility. It is a photometer for central-station use. There is also shown a very much smaller box which comprises a portable photometer for the special use of salesmen. It is said to be one-fifth the bulk of any other photometer made and measures from 8 to 32-cp on any circuit from 100 to 125 volts, and requires no voltmeter in connection with it to determine the candle-power of the lamp. This photometer requires only one working standard for all voltages. Both of these types of photometer are made by the Bryan-Marsh Company.

A prominent feature of this exhibit is a huge incandescent lamp suspended from a goose-neck support rising from the centre of the circular divan to a height of 25 feet. This lamp measures 2 feet 9 inches in length and its greatest diameter is about 15 inches. It takes 55 amperes at 236 volts, and is of the double-filament type, and its candle power is estimated at 5,000 units. The method of carrying the leading-in wires into the bulb is a new one. Some change from the ordinary practice had to be made on account of the great heat which would otherwise be concentrated at one point. The current is carried through into the bulb on the multiple principle, that is, the leading-in wires are composed of several separate wires, each of which is passed through the glass neck separately from the others. Within the bulb they are jointed to the filament in the ordinary way. In flashing the filament a barrel of gasoline was used as a treating bottle, and in exhausting the bulb four large size double-cylinder Packard pumps were required. This lamp is said to be the largest of its kind ever made. The Bryan-Marsh Company is, however, represented by a greater and more diffused exhibit than is in evidence at the booth. Bryan-Marsh 16-cp frosted lamps are arranged in a novel manner in the lighting of the great amphitheater. Numerous clusters 25 feet above the floor are distributed throughout the hall and many lamps are disposed about the girders, giving a very soft light at night.

Plass Electrical Novelties.

The H. E. Plass Electrical Construction & Supply Company, of 23 Barclay street, New York, has an exhibit which is of general interest since it deals in a line of goods which attract popular fancy. The Plass exhibit includes United States bicycle lamps, Acme electric lights, miniature lamps of all sizes, Knapp electric fan outfits, Williams medical batteries and a full line of Standard Dry batteries of all sizes, electric clocks and Gordon batteries. The most attractive specialty of the exhibit is the American Beauty electric

THE RIKER BROUGHAM.

DISPLAY OF ELECTRICAL NOVELTIES.

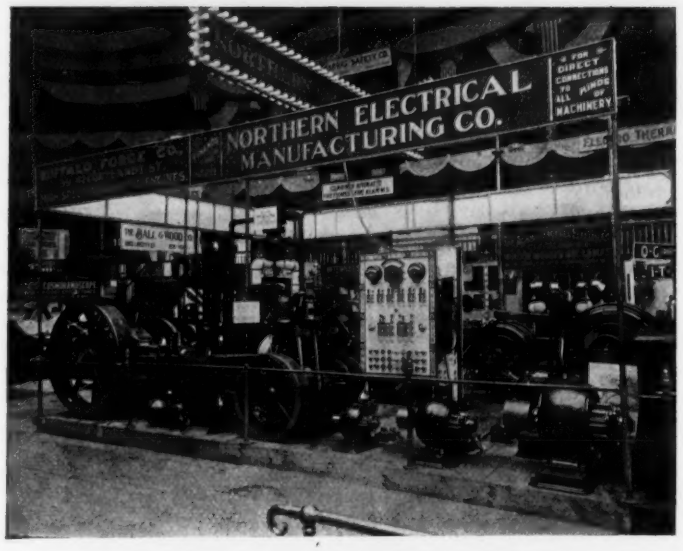
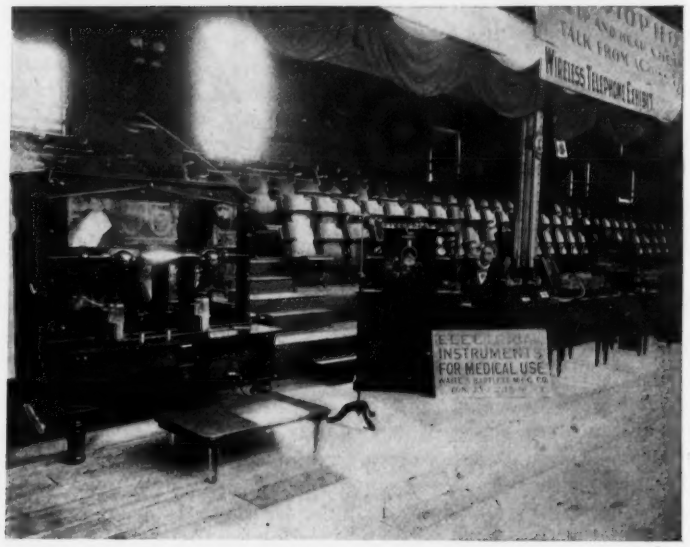


EXHIBIT OF THE NORTHERN ENGINEERING COMPANY.



PART OF THE ELECTRO-THERAPEUTIC EXHIBIT.

THE BRYAN-MARSH COMPANY'S BOOTH.

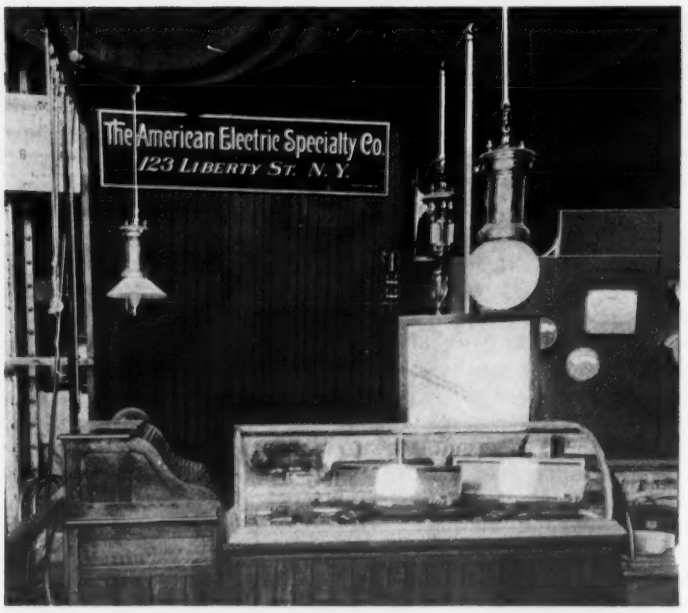


EXHIBIT OF THE AMERICAN ELECTRIC SPECIALTY COMPANY.

rose. This rose is artificial and is designed for use in the buttonhole. It encloses a tiny incandescent lamp, which is lighted by closing the two contact points of a switch which may be easily carried in the pocket. The current is supplied by a small dry battery contained in a small box which can also be conveniently carried in the pocket or elsewhere about the person. By closing the circuit the lamp is immediately lighted and forms an attractive ornament for the buttonhole. The exhibit is in charge of Mr. William Jacobs, who is the electrician of the company.

Manufactured Aluminum Goods.

The New York Aluminum Company shares the space with the H. E. Plass Electrical Construction & Supply Company and makes an exhibit of a very complete line of aluminum articles

The Electrotherapeutic Exhibit.

The excellent electrotherapeutic exhibit of the Waite & Bartlett Manufacturing Company, 108 East Twenty-third street, New York, is one of the centres of attraction of the show. It is probable that no exhibit of this character has ever excited so lively an interest among medical and dental practitioners, exceptionally large numbers of whom have been constant visitors at the garden. The Waite & Bartlett Manufacturing Company has in this exhibit most effectively supplemented the spectacular features introduced by means of its machines in the Cave of the Winds, and the static booth in the grotto, by a sound and scientific demonstration of the high standard to which the armentarium of the electrotherapist, the electro-dentist, and the X-ray expert has been brought. The Ranney-Wimshurst-Holtz static machine draws the public no less than the professions, and crowds sit fearlessly on its platform and enjoy its soothing and refreshing impulses. It is safe to say that this machine has opened up a new electrical education to many thousands of people. It has shown them that there are other healing electrical currents than those which fill delicate patients with nervous apprehension.

On view also is the Van Woert cataphoric apparatus, manufactured by Waite & Bartlett. "Painless dentistry" has long been, to a great extent, a mockery and a delusion; but it is now an accomplished fact. Cocaine, or other anaesthetic is driven by electric current into the tooth, which is quickly benumbed, and can be stopped, excavated, or extracted, without any sense of pain. For this purpose the Van Woert apparatus is favored by a large section of the profession, and good accounts are given as to its controllability, and of the way in which it is cutting down the period between the turning on of the current and the completed operation. The varieties of this instrument include the simple cataphoric outfit; that with the milliameter and current controller; and that which to these adds a faradic attachment. With these are shown the numerous electrodes which have in recent years been invented to meet every kind of dental exigency, cabinet lamps for medical and dental use, static chargers, and other appliances. Among other features of the exhibit are the 30-cell portable galvanic battery, the Englemann portable faradic battery, and the nasal electric motor. The quality of the machines turned out by Waite & Bartlett is recognized throughout the country. Their static machines, in particular, are known for their reliability in weather in which many types refuse to work.

Of the novelties shown by this firm at the Garden, without doubt the most interesting is the phono-faradic massage battery, designed by Dr. Henry C. Houghton. This instrument, which is the outcome of Dr. Houghton's many years of investigation and experimentation in aural massage, has created much comment and wide discussion as to its probable influence in introducing a radically new treatment in ear disease, and deafness. There are certain forms of impaired hearing which are most difficult to treat, from the impossibility of reaching the seat of the trouble. The massage from this battery, which is taken by eartubes, as in the phonograph, permeates every part of the abnormal region. It gives two kinds of vibration, electrical and mechanical, both emanating from the same cell. The bombarding of the mechanical vibrations breaks down the adhesions on the small bones, while the tonic properties of the electric current strengthen the weakened nerves and tissues. Testimony as to the exceptional interest evinced by the medical and dental professions in this exhibit is found in the fact that Waite & Bartlett have received a large number of orders for various machines during the exhibition. The exhibit is in charge of B. & E. Hanfeld, who have been long and favorably known to the medical and dental profession.

Exhibit of the American Electrical Specialty Company.

The American Electrical Specialty Company, 123 Liberty street, New York, has a booth on the south gallery. Its principal exhibit consists of the direct reading ohmmeter manufactured by this company. This instrument is a companion for the portable ammeter and voltmeter. It is constructed on the Wheatstone bridge principle and its readings are direct in ohms. In addition to this important feature, the instrument is extremely simple in construction, a telephone being substituted for the galvanometer. Besides the ohmmeter are exhibited a Monarc lamp, the company's new automatic switch and a diagnostic set, for the examination of the nose and throat. The switch referred to is constructed for heavy duty in opening and closing circuits carrying heavy currents. In multiple with the copper jaws of the switch, in the double-pole type, is an arm carrying two carbon contacts. Opposite these contacts and connected with the copper jaws are two other carbon contacts. When the switch opens, the copper strip leaves the contacts and the current shunts through the carbon blocks which break and take the arc which would otherwise come on the copper. In the single pole type of switch there are four contacts in multiple with the copper-connecting piece, and the arc is split up in four small parts. These switches have been in use making and breaking 75 amperes, 1100 times a night, for 8 months, the current being on for ten seconds and off ten seconds. The solenoid which operates the switch takes its current from the main, through a clock which makes contact every ten seconds. The current consumed by the magnet is said to be less than one-third of an ampere. These switches can be used for throwing on a heavy bank of lamps at a distance by simply pushing a button. The principal field, however is that of flashing electric signs. The feature of the diagnostic set is that it is made entirely of glass and is easily sterilized. Two candle-power lamps are used for the illumination.

The Union Boiler Tube Cleaner.

At the Fourth Avenue end of the Garden on the main floor is an exhibit of some large apparatus which is of special interest to steam users. It is that of the Union Boiler Tube Cleaner Company of Pittsburg, Pa. There are shown four machines illustrating the methods of cleaning the tubes of different types of water-tube boiler. The machines are in practical operation and tubes are shown which have been entirely cleaned and others partially cleaned. This cleaner is a mechanical device operated by power for totally removing all scale from the interiors of both straight and curved tubes of water-tube boilers, economizers and all scale and soot from the interior of the smoke flues of tubular boilers, also of matter adhering to the interior of tubes and pipes used in industrial enterprises. The company has increased the steaming capacity of oil boilers from 28.8 per cent. to over 100 per cent., the latter figure, of course, representing cases of bad incrustation. The cleaner is of the impulse type. The cleaning head is composed of three arms, each bearing eight cutter wheels graduated in size, and the hose connection with ball guides enables the cleaning head to adjust itself to the formation of either straight or curved tube boilers. The cleaner is driven by rope transmission, the slack being provided for by pulley, rope and counterweight. The cleaning head is operated at from 1200 to 2000 revolutions per minute, depending on the diameter of the tube to be cleaned. Mr. E. T. Rowand, president of the company, is in attendance part of the time. The exhibit is in charge of Mr. J. M. Shaver of the home office, assisted by Mr. H. F. Pore.

Eschweis Enclosed Arc Lamps.

The Universal Electric Pull Socket & Switch Company, 35 South William Street, New York, has a neat little booth on the main gallery where it makes a display of the Eschweis '99 enclosed long-life arc lamp, which is manufactured by this company. Rising from the floor of the booth is a gas-pipe standard at the top of which are four arms, each arm supporting an Eschweis lamp. Three of these lamps

are in practical operation, the casing of the fourth being removed in order to permit of an examination of the mechanism. The Eschweis lamp measures 17 inches over all and can be used for decorative work and store windows to advantage. It can also be made in any fancy design to suit individual tastes. The lamp is designed for constant-potential circuits and is extremely simple in construction. No regulation is required for change of voltage, and the mechanism is free from springs, dash-pots or gears. The light given by this lamp is very steady and white. The Eschweis lamp is used in many large business houses in New York and uniform satisfaction with them is reported. Of the three operating lamps on exhibition, one has a handsome cut glass globe, while the other two have porcelain and light yellow shades. Two Eschweis lamps are shown in the exhibit of the Jos. Dixon Crucible Company. In addition to the lamp exhibit the company is showing some of its pull sockets. This is a very convenient device. By simply pulling a chain pendant the light is turned on or off from the lamps. These pull sockets can be connected up so as to control a single lamp or any number of lamps, and they practically do away with a wall switch. It is claimed that from 25 to 40 per cent. is saved in wiring and labor by the use of these pull switches.

THE ESCHWEIS '99 LAMP.

Safe and Accurate Fuses.

BY JOS. SACHS.

THE use of so-called "safety" fuses for the protection of electrical apparatus from various forms of overload has in the past been a fruitful source of trouble and dissatisfaction. Yet the much maligned bare-wire fuse cut-out has been found an essential protective device in almost every branch of applied electricity, and certainly has contributed greatly to the ultimate commercial success of such systems of electrical transmission.

It required, however, but a short time to demonstrate the fallacy of considering any electrical apparatus or wiring installation as safe which is protected with open and exposed fuse cut-outs unless under stringent precautions. Notwithstanding the perfection of nearly every other element entering into the electrical distributing system, the safety fuse of to-day in the form of bare wire, links or plugs, is the open wire air exposed safety fuse of the beginning, refined perhaps in detail, but still lacking safety, accuracy and constancy of action. On the other hand, cheapness, simplicity and the peculiar advantages of a thermal line interval protection for most classes of electrical service, have caused its retention, although generally conceded to be a necessary evil.

At the present time, when electrical development seems to point towards higher voltages and increased safeguards, the advent of a perfected fuse cut-out free from all past fuse ills and yet retaining all the merits of such protective appliances, is certainly a much needed device. The enclosed type of fuse, though vastly superior to the open fuse, is yet deficient unless it embodies all of what may be said to be the essential qualities of a perfect fuse. Such a fuse must for any particular voltage and at its rated ampere capacity be capable of indefinite service; operate at excess current in a time interval inversely dependent on the overload; open the circuit without arc or flash and yet positively show to the observer its condition at all times; be absolutely constant, unaffected by ordinary atmospheric condition and constructed so as to be easily manipulated. Reasonable cost is also a highly essential element, but it is to be regretted that the electrical fraternity has allowed itself to inquire but too frequently "how cheap" and not "how good" when looking into the merits of any new appliance.

In the development of safe and accurate fuses extensive laboratory and practical test in service are the best assurance of merit. Although a pioneer in the development of safe and accurate fuse protection, and, in fact, the subject of a patent over six years ago, the fuse illustrated herewith, known as the "Sachs Noark" fuse, is, in the form here shown the result of almost three years constant experiment. Its commercial debut, however, has been withheld until every desirable feature had been attained. The fuse is made in

FIG. I.—NOARK FUSE, TYPE A.

different sizes for all voltages and any ratings ranging from 1 to 200 amperes. The exterior simply shows a neat fibre tube, at each end of which is a brass ferrule, which ferrules either form the contact terminals, or separate contacts of the standard hook type are attached. Inside of the interior tubular casing is a special alloy fuse wire entirely encased in a surrounding material. There is no air in contact with the wire throughout its entire length. The surrounding material and its arrangement about the wire play a most important part; in fact, are the prime elements in the accurate positive action obtained. In operation under the most severe overloads or short circuits, the rupturing of the wire is not accompanied by any flash or arc whatsoever, as would be the case were the wire passed through an enclosed air chamber. In place of such action, the blowing of the fuse simply results in the combination between the metal of the wire and the surrounding material, resulting in the formation of a strata of insulating material between the terminals.

The peculiar advantages of the arrangement adopted in this fuse manifest themselves, particularly when compared with fuses in which the wire is surrounded either partially or wholly by air. All oxidation of the fuse wire is absolutely eliminated, and the operation of the wire at a certain predetermined temperature is not only a function of the wire, but also a function of the surrounding material itself through its action upon the wire. This feature insures absolute constancy at all times, as in no way can the wire either decrease or increase its carrying capacity by ageing, the surrounding material being of such a nature as to positively operate at the predetermined point.

It is quite obvious that the instantaneous rupturing of inductive circuits is accompanied frequently with disastrous results due to inductive discharge, and it is clear that the proper way to shut off the current in almost any electric circuit is not to do it instantaneously but gradually though quickly. The fuse illustrated does this in the ideal fashion, not instantaneously rupturing the circuit, but acting gradually and yet quickly, owing to the combination of the wire and the surrounding material. It will be appreciated that this advantage is most apparent on overloads. In the case of short circuits, it is perhaps not as defined, inasmuch as it is desirable to prevent the rush current reaching too high a point.

All enclosed fuses in which the fuse wire is encased in a jacket which hides from the observer the action and condition of the wire, are deficient through not indicating to the observer or user their condition at any and all times. It is quite obvious, particularly in

the case of high tension circuits, that where the condition of the fuse cannot always be seen, disastrous results may and have followed, owing to the ignorance of the user as to the actual condition of the fuse wire within the casing. It is believed that a long step in advance of all prior attempts in this direction has been successfully made in this new thermal protective device.

The "Noark" fuse does not arc, but indicates. That is to say, the condition of the fuse wire in the casing is at all times apparent to the observer. This valuable feature, and it may almost be said, indispensable adjunct, is obtained by placing on the outside of the casing a very fine resistance wire, which is connected across the terminals at the ends of the tube, and in shunt with the main fuse

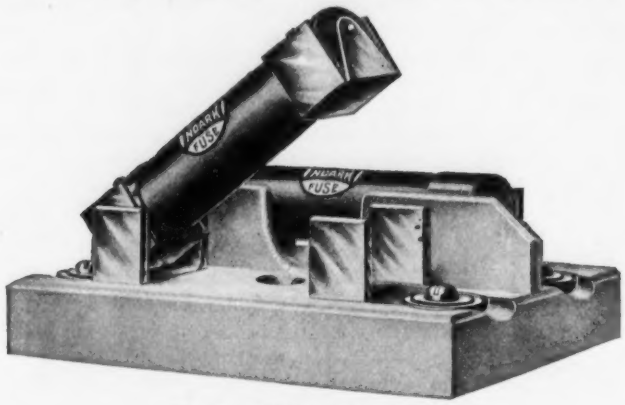


FIG. 2.—NOARK FUSE, TYPE C.

wire within the case. As long as the main fuse inside the casing is entire and has not operated, the small shunt wire, which is practically short-circuited by the inner wire, remains complete and carries practically no current, owing to its vastly greater resistance. As soon, however, as the inner wire has been ruptured, the current rushes through the outer indicator wire, which it instantaneously ruptures, leaving upon the exterior casing a slight yet strongly defined black line. This indicator wire is so small and its disruption so instantaneous, owing to the small amount of metal volatilized, that absolutely no effects of a disagreeable or undesirable nature result.

The various fittings for these fuses, such as cut-out blocks, bases, etc., embody a number of desirable features. "Noark" fuses are provided with three forms of terminal fittings—types *A*, *B* and *C*. Type *A* terminal fittings are the well known hooked type, as shown in the illustration, and are used on 500 and 2500-volt fuses generally. Type *B* fittings embody a departure from common practice and possess the advantage of requiring no screw driver or screws to replace fuses. Type *C* fittings are similar to type *B*, but have flat contacts at the end of the fuses instead of round. Types *B* and *C* fuses will be appreciated particularly for low tension work, such as incandescent light and power distribution. These switch clip contacts are used on all "Noark" 220-volt fuses and contacts and also on various other high potential fittings.

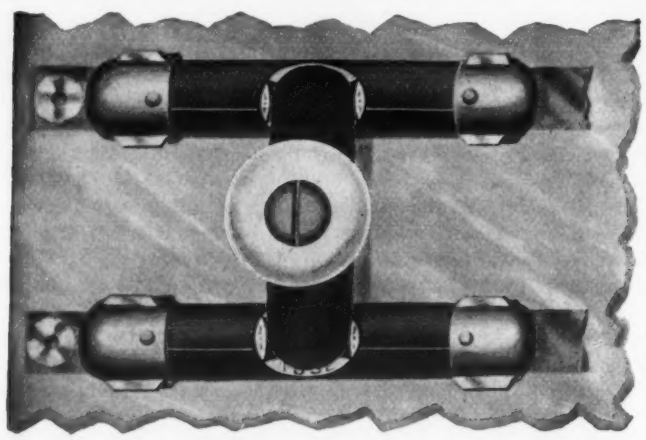
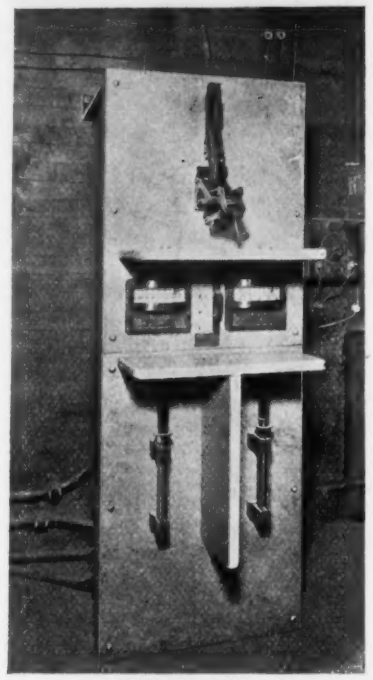


FIG. 3.—NOARK CARRIER.

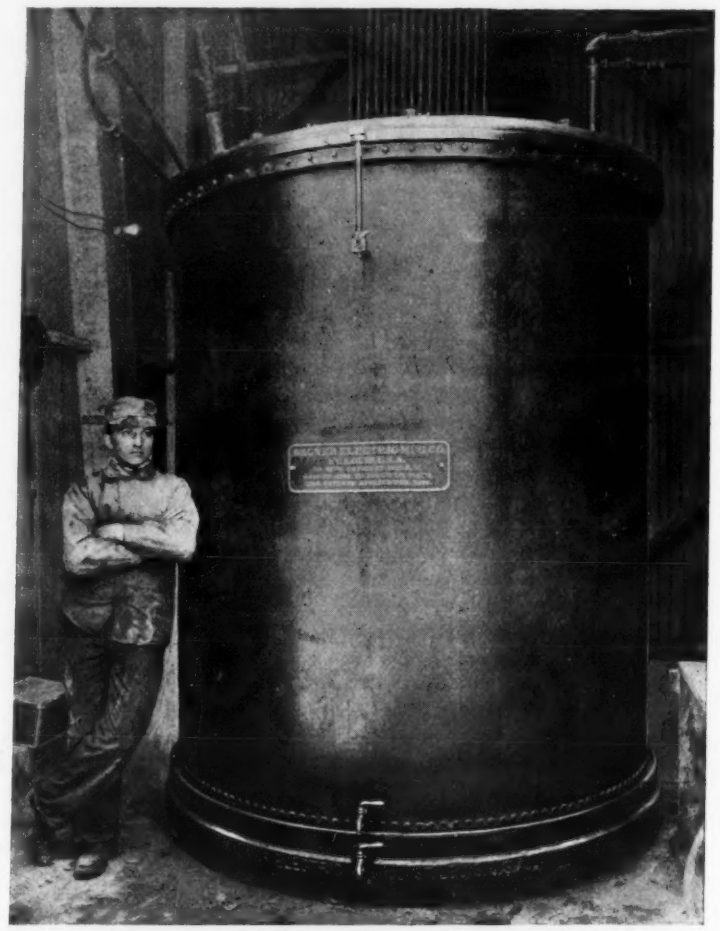
Another device, known as the "Noark Carrier" enables the use of two or more fuses, which are held together rigidly as a switch and fuse combined. This device is particularly intended for panel board use and is clearly shown in the illustration.

A 2,000 Horse Power Transformer.

The transformer illustrated below is the first one of the set of seven 2000 hp units which the Wagner Electric Manufacturing Company of St. Louis, Mo., is to furnish to the Carbide Company of Niagara Falls. It has been in successful operation for three weeks, carrying approximately 10 per cent. overload continually during that period, with an increase of temperature above that of the surrounding atmosphere of 30 degs. C. Near the centre of the top of the iron case is an oil gauge, serving the combined purpose of indicating the oil level and also the temperature of the oil on a thermometer enclosed within the gauge. The inlet and outlet pipes to the water cooling coil which surrounds the transformer proper inside of the case are shown at the top of the picture, while at the centre may be seen the series of sixteen secondary bus bars which convey the load current of 16,000 amperes at a pressure of 110 volts to the carbide furnaces. The primary leads, which are supplied direct from the 2000-volt switchboard in the plant of the Niagara Falls Power Company, are shown at the left.



SWITCHBOARD.



2000-HP WATER COOLED OIL TRANSFORMER.

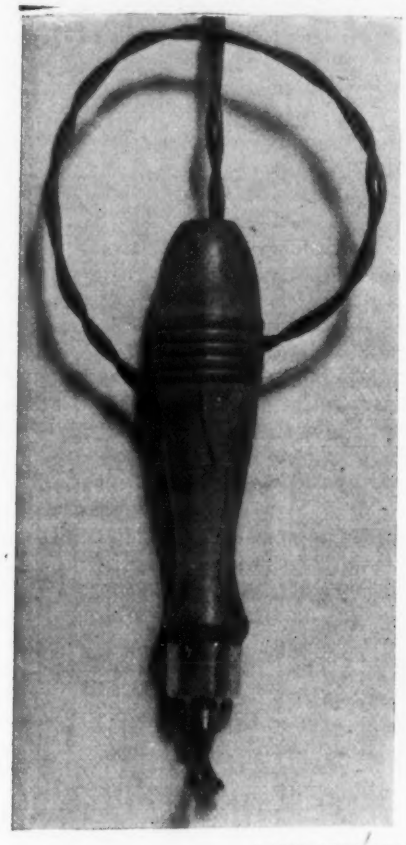
In the first illustration is shown the switchboard which controls the primary service of the transformer. At the top of the panel is a circuit breaker, below which are an indicating voltmeter and indicating wattmeter, and ordinary knife switches for permanently opening the circuit.

Combined Socket Handle and Cord Adjuster.

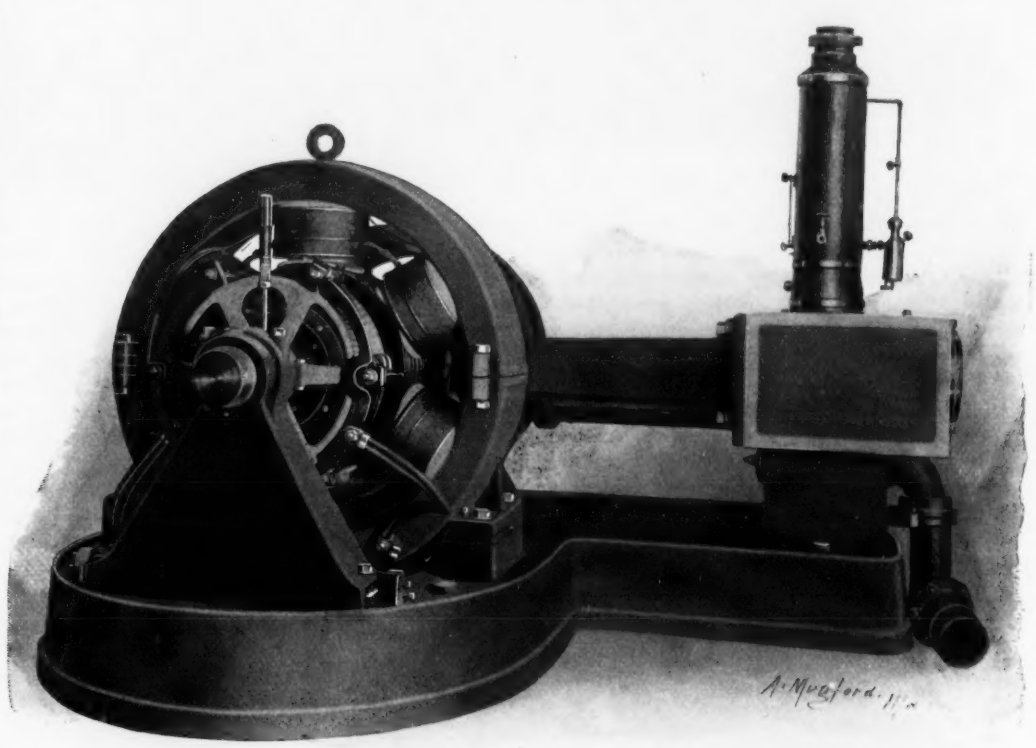
Not all of the many devices on the market for varying the length of incandescent lamp cords give the best results. To overcome the objections met with in the use of these Messrs. Frank H. Stewart & Co., 35 North Seventh street, Philadelphia, Pa., have brought out the combination device shown in the illustration below. An evident advantage of this adjuster is that the means of readjusting the length of the cord are near the lamp itself, and the necessity of making high reaches to accomplish this result is obviated. The ferrule at the lower end of the handle is of brass and forms a solid connection with the socket. The cord entering the top of the handle emerges at the left side; it then forms a loop, passing into the handle again on the right side, as shown, and down to the lamp socket. The cord can be readily adjusted by means of this device, being held in a firm grip and held securely in place.

Onondaga Direct-Connected Generator.

In a past issue of the ELECTRICAL WORLD AND ENGINEER mention was made of a direct connected electrical plant furnished to the



LAMP CORD ADJUSTER.



DIRECT CONNECTED ONONDAGA DYNAMO.

Syracuse University by the Onondaga Dynamo Company, of Syracuse, N. Y.

The generator (a cut of which is shown herewith) is direct connected to a "Straight Line" engine and placed in the new Steele Hall of Physics on the University grounds, a fine new building built especially for the generator and other machinery to be used in the electrical engineering course.

It is of 30-kw capacity and is of the Onondaga ring type. The magnet ring is made of a special mixture gray iron and is generous in proportion, neat in design, and pleasing to the eye. It is cast in two pieces, which, when bolted together, give a joint of neat appearance.

The magnet cores are made of soft charcoal forged iron, and are cast welded in the magnet ring, thus doing away with all unnecessary bolted joints, which are a source of loss in any magnetic circuit. The pole shoes are bored out and slipped over the magnet cores, thus allowing the wrought cores to extend through to the air gap, and are so shaped as to eliminate all humming noise.

The bearings are of the self-adjusting, self-oiling, ball and socket type. They are fitted up with the greatest care and accuracy, and are constructed in a manner to avoid all leakage of oil on or about the machine. A glass oil gauge is provided on each bearing, and shows the amount of oil in the chamber at all times.

The armature core is built up of discs made from the best grade of charcoal iron. The discs are brought together under heavy pressure, and are firmly held in place by heavy cast iron end plates, and slots are then provided to receive the wire. Openings perpendicular to the axis are provided through which by centrifugal force is passed a constant current of air, entering the core through openings at each end, which keeps the armature at an exceedingly low and even temperature. The armature core is probably the most particular part of a dynamo, and unless it is constructed with the greatest care, and with the best materials, it will cause more trouble and waste of power than any other part of the machine. Before placing these generators on the market large sums of money were spent in testing different materials and methods of construction, and results are therefore guaranteed.

The commutator is of generous proportions and has a large brush contact surface. The segments are insulated by mica of uniform thickness, and are pressed together by a special device. The commutator is thoroughly ventilated, the inner surface having a complate exposure to a free current of air. The shaft is made of forged steel, and accurately turned to gauge. A neat coupling is fitted on the end, thus connecting the dynamo to the engine.

The brush holder is novel, and so designed that a uniform bearing surface is obtained with a minimum pressure, thereby causing the smallest amount of friction upon the commutator and in nowise causing any heat on account of brush friction. The brushes are easily removed by the students while the machine is in operation. Carbon brushes are used, which are made accurately from the company's own blue prints. The field coils are wound upon insulated spools; the shunt and series coil being separated by a fibre insulating ring, and both coils are protected by a covering of fine cotton cord.

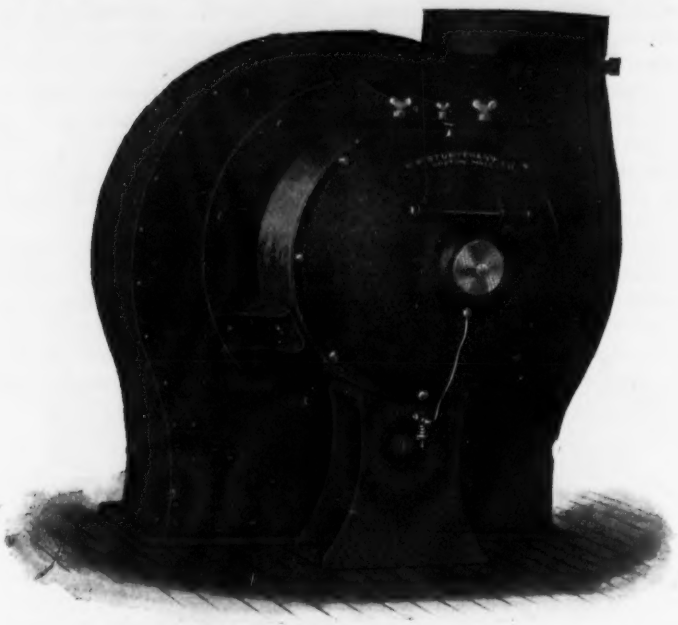
Enclosed Electric Fan.

The demands of manufacturing frequently make it necessary that motors attached to fans should be thoroughly enclosed and protected from dust or moisture. This is particularly true in the case of the iron industries and in foundry practice. To meet this demand the B. F. Sturtevant Company of Boston, Mass., is building a line of en-

closed electric motors with encased blowers as shown in the accompanying illustration.

The field ring of the motor forms a part of the enclosing shell, which is completed by the attachment to the hemispherical ends as shown. The ring is attached to and centered by three lugs projecting from the fan side. As both ends of the motor are enclosed, there is no opportunity for the drawing of dust across its moving parts.

The door in the outer end permits ready access to the interior. In



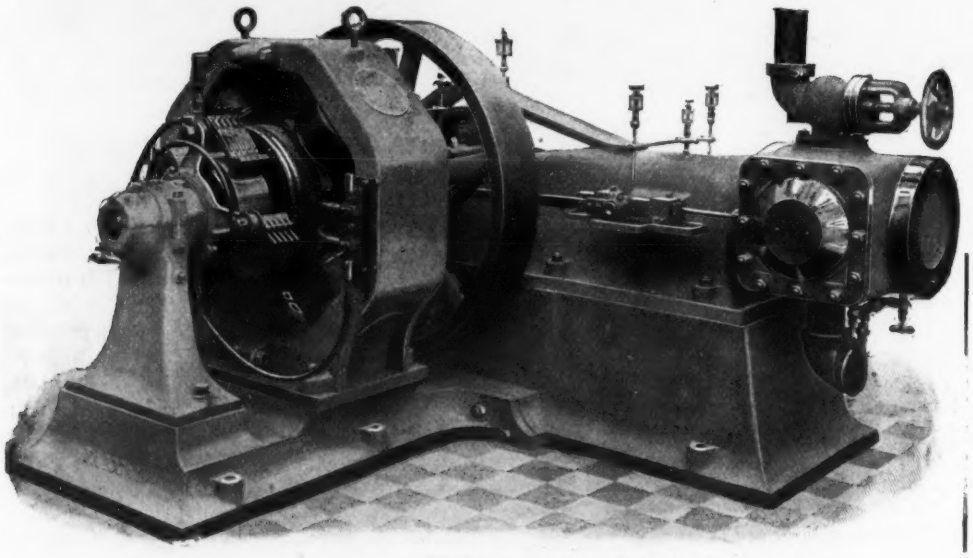
ENCLOSED FAN.

small sizes such a fan is readily portable and of great utility under many conditions, for it is particularly true in foundry practice that a fan might often be placed much nearer the cupola if it were not for the inconvenience in transmitting power, but with such an arrangement it is feasible to place it in close proximity.

Direct-Connected Jenney Generator.

The accompanying illustration shows a 20-kw engine type generator built by the Jenney Electric Mfg. Co., of Indianapolis, Ind. This type, in sizes up to and including 20-kw, is constructed with four poles, and with six poles in sizes from 25 to 100-kw.

The field frames are parted on a vertical line, enabling either half of the field to be slid out and away from armature, thus giving



DIRECT CONNECTED GENERATOR.

free access to the field coils without disconnecting the engine or lifting either half of field, or armature, as would be the case where the field is parted on a horizontal line.

The field cores are made of annealed wrought iron, and are forced by hydraulic pressure into the field frames. The armatures are of the slotted core type, and provided with form wound coils. The armature is secured on the engine shaft by an improved form of coupling, which entirely overcomes the difficulty heretofore experienced in forcing the armature on to shaft.

Special Telephone Dynamo.

The introduction of a luminous signal in telephony and the tendency to centralize the transmitter batteries of the subscribers at the central office have introduced new factors in telephone work. While storage batteries have been replacing the primary battery in supplying energy for this work, it has always been felt that if the current could be taken direct from the machines a much more desirable, cheaper and efficient service could be given. Appreciating the requirements and understanding the necessity for a dynamo specially designed for this class of work the Holtzer-Cabot Company, Brookline, Mass., has developed a line of machines which is said to be meeting with a hearty endorsement from some of the largest telephone companies.

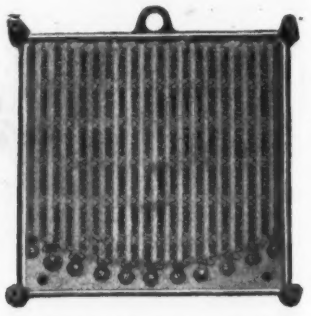
The current commutated from this machine is so even and smooth that it can be connected direct to the transmitter circuit without the slighest perceptible noise being heard in the receiver. These generators are usually wound to about 30 volts, so that by the introduction of suitable resistances the one machine can be made to furnish current for the various applications rendered necessary in a central energy system requiring different voltages. They may also be used in the place of storage batteries, where uniform and steady current is desired.

A Continuous Duty Rheostat.

A new rheostat for all continuous duty purposes, motor speed regulators, for example, is illustrated herewith. This rheostat contains some new features, and is extremely compact. A cast iron plate has parallel ribs extending along the back; between these ribs are long slot-like openings so that a grid-like construction is obtained. The entire back surface of the grid, including the walls on both sides of the ribs, is covered with porcelain enamel. A coil of wire is then placed between the ribs and over the slot and attached by enamel to both side walls of the ribs between which it lies. The ribs extend up high enough to thoroughly protect the coil lying between them in the V-shaped space.

It will be seen that this construction gives excellent ventilation, at the same time holding the coil at two points in each whorl of the coil. This attachment of the wire, at intervals only, leaves it free to expand without producing any breaking strain on the enamel, and yet the attachment permits of a free conduction of heat to the entire surface of the cast iron Thus the unusual result is obtained of having the best conditions for heat convection by air currents, together with the large heat absorptive capacity of the grid with the extended ribs.

This rheostat is the invention of Mr. H. Ward Leonard, and is manufactured by the Ward Leonard Electric Company, of Bronxville, N. Y.



CONTINUOUS DUTY RHEOSTAT.

The grid shown in the illustration is one of forty sold to the South Side Elevated Company at Chicago, and is 10 in. x 10 in. with a resistance of 200 ohms. It will be used directly across 600 volts, and will therefore carry 3 amperes continuously and dissipate continuously 1800 watts.

A New Portable Cable Testing Outfit.

The apparatus illustrated herewith is so constructed as to facilitate the usual measurements on cables. The galvanometer (Fig. 2) is of the Queen pattern and fitted with telescope and scale, which are very short, thereby rendering the instrument compact and stable.

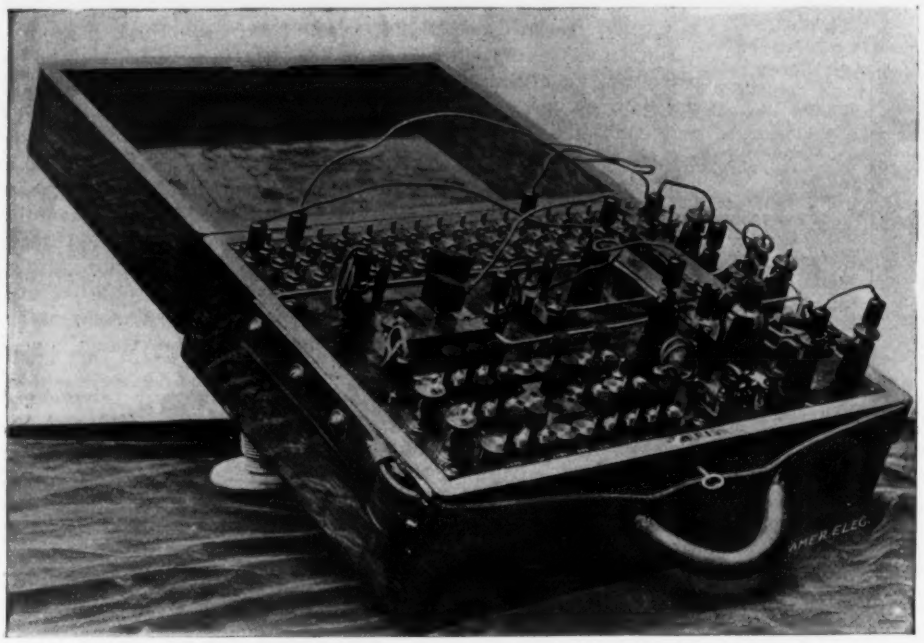


FIG. 1.—PORTABLE CABLE TESTING CASE.

The scale is a photographic one, and although less than five inches long, is so finely graduated and highly magnified as to permit of accurate reading of the deflection. The tripod is a transit tripod, which when closed is very short, yet when open is perfectly solid.

The testing case (Fig. 1) contains everything for making Wheatstone's bridge, resistance measurements, direct deflection, insulation measurements, capacity tests and the Varley and Murray loop tests; if desired, insulation measurements by loss of charge.

The set has been most carefully laid out, and all parts designed and constructed with the utmost care. High insulation is secured throughout by means of polished and corrugated hard rubber pillars. All connections are in sight, and made by means of copper rods run clear of everything. For any tests requiring high insulation there is no low insulation point permitting leakage. For example, when the Wheatstone's bridge is not in use it is entirely cut out by means of a switch, thereby avoiding any possibility of vitiating capacity or insulation tests.

The insulation of all contacts under the rubber base is kept high by running the hard rubber pillars clear through and corrugating below as well as above the rubber plate. The galvanometer when used ballistically gives deflections strictly proportional to the discharge. When used for direct deflection measurements the deflections are strictly proportional to the current, and it is thoroughly dead beat.

In changing from one test to another but a few single alterations have to be made in the flexible connectors. Diagrams accompany the outfit illustrating all connections and changes.

The outfit is made by Messrs. Queen & Co., Inc., Philadelphia, Pa. It comprises galvanometer, extra system, telescope and scale, tripod, subdivided condenser, standard high resistance, galvanometer shunt (Ayrton form), cable posts, 50-cell battery,' Wheatstone bridge, capacity and short-circuit keys, reversing switch, carrying case.

Eureka Central-Energy Generator.

To meet the demand for a practical and reliable machine to take the place of hand generators in telephone exchanges, particularly in those exchanges where water power is not available, and where the cost for power for the operation of generators constitutes an important item of expense, the Eureka Electric Company, of Chicago, has placed in the market the machine illustrated herewith. This central-energy generator is claimed to be efficient and economical, and is ready for service day or night, requiring no other attention than an occasional recharging of a battery of four salammoniac cells. The circuit is closed by a cam lever upon the switchboard by a foot push which is furnished with the machine. The generator is designed to ring bells over lines having resistances as high as 100,000 ohms.

The machine, the manufacturer states, has been thoroughly tested and passed the experimental stage, having received a number of endorsements from exchanges in which it is used. One of the strongest features is the fact that there is no current consumption while the machine is not in use; the expense for power therefore is reduced to a minimum. The instrument is especially adapted for either series or bridging lines, and for any size of exchange, from 25 subscribers upwards. In dimensions it is 10 x 12 inches and may be placed in any convenient location, either at or away from the switchboard.

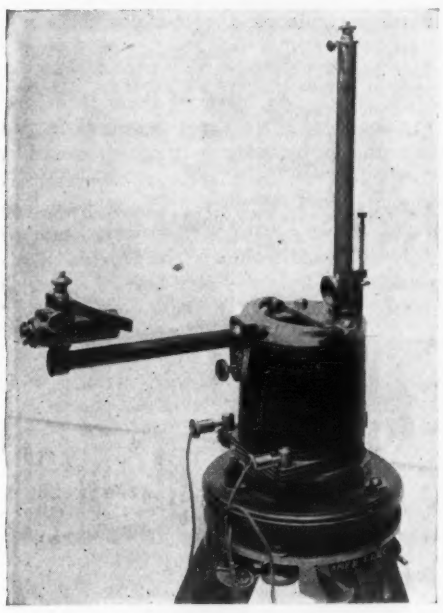


FIG. 2.—TESTING CASE.

FIG. 3.—OUTFIT IN USE.

CENTRAL-ENERGY GENERATOR.

The Excelsior Indicator.

Modern indicator practice has demonstrated beyond question that the instrument should be very light in its moving parts in order to reduce momentum to the lowest degree, while the stationary parts should be amply heavy to resist the strains incidental to high speed and pressures. In the "Excelsior" indicator shown herewith, these features are claimed to be possessed to a pronounced

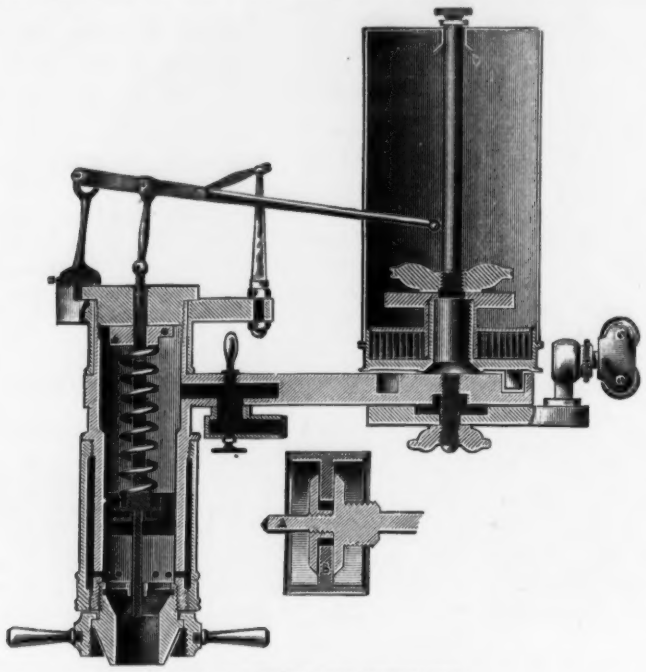


FIG. 1.—EXCELSIOR INDICATOR.

degree. The designers have stated that while the regular pattern is heavier than other instruments, they will furnish a lighter pattern where it is called for.

Among the new features to be found in this instrument will be noticed the improved frictionless piston. This feature is attained by continuing the piston rod through the piston and providing a bearing at the bottom. The piston slides laterally between two

FIG. 2.—EXCELSIOR INDICATOR.

flanges, so that no matter how much side thrust may be induced by the spring, it cannot cause any friction between the piston and cylinder. On account of this ability of the piston to slide laterally, the leakage of steam around it operates to keep it exactly in the centre of the cylinder, so there is always a film of steam to prevent the two metal surfaces from coming into contact.

The cylinder of the indicator is jacketted with live steam, so that the same pressure exists at all times around, as in it. This provides for expansion and contraction perfectly, so that there will be no binding at high pressures. The "blow" from this indicator is taken care of, by means of a swivel elbow, which may be turned in any direction. For the indication of extremely high pressures, a supplementary cylinder is provided, which may be secured in place without difficulty. In the original indicator, the coupling of the cylinder was used for the quarter-inch area piston, but as the grit contained in the steam soon cut the surfaces. This supplementary cylinder is considered an improvement.

The drum mechanism is extremely simple. The spring winder is easily rotated until the desired tension is obtained, when the thumb nut tightens upon it. This thumb nut has a left-hand thread, so that the pressure of the spring operates to tighten it more firmly. The parallel motion is of the best tool steel, highly polished and blued. It is designed to give a perfectly straight line at right angles to the atmospheric line, and the multiplication of movement is correct throughout the stroke.

The instrument is packed in a polished mahogany velvet lined case (Fig. 2), with all fittings. It is the invention of Mr. A. C. Lippincott, and is manufactured by the Engineering & Power Company, 169-171 Broadway, New York City.

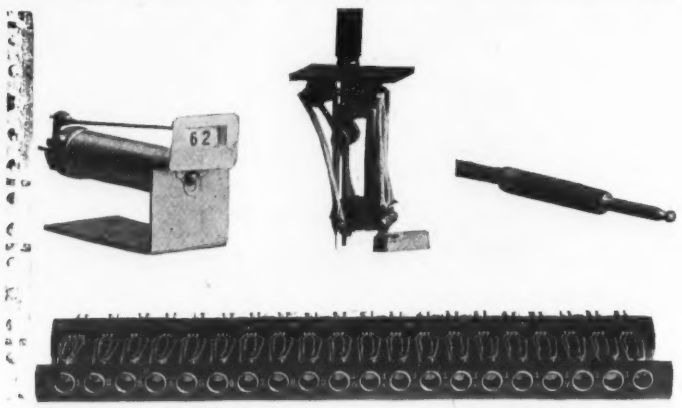
Multiple Switchboard System for Independent Telephone Exchanges.

Since independent telephone systems are being rapidly extended into the larger cities, much thought has been given to devising adequate apparatus for large exchanges. In this connection the multiple switchboard system brought out by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, is receiving considerable attention.

Fig. 1 shows a main line signal of the board used with this company's central energy system, the main part of the visual signal being similar to the ordinary drop.

The visual signal is controlled from the subscriber's station. When the subscriber takes the receiver from the hook, it automatically indicates the number at the central office. Since the "disconnect" signal is given when the receiver is replaced, the operator need not break in during a conversation.

Fig. 2, shows a ringing key and Fig. 3 the plug. Fig. 4 shows a bank of twenty multiple spring jacks. As many of these jacks are placed in each section of the board as there are subscribers in the entire exchange, one for each station, bringing each operator within the reach of every subscriber's line. This enables an operator to complete a connection between any two subscribers. The jacks, while very small and compact, are of ample size to permit every detailed part being made strong and durable. All contacts are provided with platinum points. The manufacturers state the very best of material and highest class of workmanship are used in the construction of



FIGS. 1, 2, 3 AND 4.—DETAILS OF MULTIPLE SWITCHBOARD.

this apparatus, the details of which have been most carefully studied out to secure smooth and perfect operation.

NEWS OF THE WEEK.

Financial Intelligence.

THIRD AVENUE.—The Third Avenue Railroad Company of New York City, in order to meet the expenses which will be incurred by the change in motive power to electricity, will issue new stock to the amount of $20,000,000.

NEW SECURITIES.—At the New York Stock Exchange the Erie Telegraph & Telephone Company has listed $2,000,000 additional collateral trust 5 per cent. bonds issued to take up stocks of subsidiary and controlled companies. The company earned in the year ending Dec. 31, surplus over dividends, $6573.

NEW YORK CITY.—The New York Gas & Electric Light, Heat and Power Company, through the Central Trust Company, has opened a subscription for $5,000,000 of its contemplated issue of $15,000,000 5 per cent. gold bonds. The money is to be used for the purchase of the Edison Electric Illuminating Company.

CONNECTICUT.—Plans looking for the combination of most of the prominent street railways of Southern and Central Connecticut are under way. A. M. Young, of Waterbury, A. M. Paige, of Bridgeport, and a New York syndicate are interested. The purchasing company is to be the Connecticut Lighting & Power Company. Anything that A. M. Young puts his shoulder to, goes and gets there.

A TRAFFIC CONTRACT between the Brooklyn Rapid Transit and the Metropolitan Street Railway Company, which involves the transfer of passengers over Brooklyn Bridge is in preparation. It is not known whether the plan is to run cars from one borough to another or merely to give transfers at a reduced rate at Brooklyn Bridge. But it will be a good thing for the public and the companies anyway.

BOSTON ELEVATED.—Current earnings of the Boston Elevated road are stated to be showing very large increases over those a year ago. One who should have excellent sources of information states that the gross earnings this fiscal year will show an increase of between 15 and 20 per cent. over those of last year. Suburban electric roads are reporting increases in their earnings, running in some cases as high as 50 per cent. above those a year ago.

GENERAL ELECTRIC.—The declaration of the dividend of 1½ per cent. on General Electric is to be understood as the establishment of the company on a 6 per cent. basis. There is no reason to believe that 6 per cent. will be the maximum dividend on the stock. The company could, it is asserted, very easily pay 8 per cent. under existing business conditions, or it might pay 6 per cent. regular dividends and extra dividends as the circumstances warranted. In such event the stock might very reasonably sell on a 5 per cent. basis.

METAL MARKETS.—Iron and steel appear to be going up still in price, and there is no let-up in the demand. Minor metals have followed London so long that tin sticks at 25.65 cents, though stocks are large and the demand is remarkably poor, and lead at 4.45 cents, though the demand is slow, while copper weakens to 18½ cents for Lake, British statistics indicating a fall of nearly a quarter in consumption for four months this year compared with last. There is no question that the very high price of copper has had a tendency to check consumption, or to cause old metal to be worked over again.

ELECTRIC VEHICLE STOCKS.—Much activity has been seen in New York City in the various vehicle and transportation company stocks. Electric Vehicle was sold down below par on a free offering of stock, said to be for weak marginal accounts, and Transportation broke in sympathy. There is, however, good reason to believe that much of the weakness of these electric stocks was the result of the introduction in curb market of the stock of the General Carriage Company, a $20,000,000 corporation, which, it is fondly alleged, is about to institute a cheap service of cabs propelled by air power in New York City. The company will operate under the Hoadley patents, controlled by the International Power Company and the New York Auto-Truck Company. There is a very good demand for both International Power and General Carriage stocks, and higher prices are promised by insiders. When the air cars and carriages materialize, it will be time enough to buy stocks in them. But not before.

THE WEEK IN STOCKS.—The week's stock market has been irregular, but on most days very weak. The bad reports from the wheat district, the pendency of the Ford franchise tax bill, and the reduction of one large gas company's dividend were all used against the market. Total sales of stocks on the New York Stock Exchange were 2,305,719 shares, against 3,048,009 last week, and 1,855,119 for the corresponding week last year. There has been continued buying of railway and miscellaneous bonds, and many substantial gains were recorded. Total transactions on the Stock Exchange aggregated $21,140,500, against $24,681,500 last week, and $12,845,300 for the same week in 1898. Government bonds were moderately active, and prices were advanced ⅛ to 1¼ per cent. Money at New York and other domestic centers has grown easier all the week. Of Western Union Telegraph, 3607 shares were sold, closing around 92. General Electric was weak and declined on sales of 5465 shares, but rallied to 118. Brooklyn Rapid Transit had a busy time, and on sales of 273,000 shares closed at 111⅜, a decline of nearly 4 points for the six days. Metropolitan Street Railway closed at 220¾, on sales of 29,710 shares. In Boston, American Bell Telephone closed at 340 bid; Erie Telephone, 94; New England, 145; Michigan, 92, and Mexican, 3¾. Boston Elevated was quoted at 108. In Chicago, National Carbon common sold at 19; South Side Elevated at 96. In Philadelphia, Electric Storage Battery pref. and common was quoted at 150 to 160; Pennsylvania Electric Vehicle Company at 16¼; General Electric Automobile at 9, and Union Traction Company at 41¼.

THE STATE OF TRADE.—Bradstreet's report of the state of trade says: "Favorable features of current trade still as for a long time past largely outnumber those of an opposite character. Wholesale distribution is naturally less active as the season advances, but comparisons with last year are still very satisfactory. Much is hoped for from better weather conditions stimulating retail trade, hitherto held in check by the backward spring season. Industrial activity is widespread, and the prices of most staples are either very firm or tending upward, except in the cases of products affected by weather conditions." In their weekly review of trade Messrs. R. G. Dun & Co. say: "There is some fear that has no other source than the habit of fear. Men have found for so many years disaster treading on the heels of apprehension that they lack faith in good things present and to come. Every year there is worry about short crops, and yet the crops grow larger. The spectre of monetary trouble haunts men who know that the country is strong beyond any need. Promoting methods alarm men who are really quite aware that it is only needful to put promoted stocks in a class by themselves. But all the time the volume of business is rising, and the week's payments through the chief clearing houses are 62.1 per cent. larger than last year and 68 per cent. larger than in 1892. For the month thus far the daily average is 57.9 per cent. larger than last year and 66.4 per cent. larger than in 1892. Moreover, this week and every other brings larger wages to many, and increased purchasing power, and the demand for products is consequently expanding in all branches of consumption."

NORTH AMERICAN.—The North American Company is about to issue to its stockholders a plan for financial reorganization. This company is the successor to the one organized by Henry Villard, and which operated for years under the title of the Oregon & Trans-Continental Company. For some weeks past there has been a steady accumulation of the company's stock by prominent Wall street interests, some of them said to represent Messrs. J. P. Morgan & Co. The buying has been based upon the coming issue of a scheme for readjustment of the capital in such a way that the earnings which it now realizes will in part become available for the proprietors. It is proposed to exchange for the present stock equal amounts of new common and preferred stock, although, if the ideas of certain banking interests are respected, both classes will be somewhat cut down from these figures. It is believed that the company can easily earn and pay 4 per cent. dividends on the proposed issue of preferred, and that the common should have as good a standing in the market as the old common has had for a series of years past. The company controls a good interest in the Cincinnati Electric Light Company, which was one of its treasury assets it succeeded in retaining at the time of the collapse. Another and more important asset is a large interest in the securities of the Milwaukee Street Railway Company, whose bonds have only recently taken a good stand in the investment market. The Milwaukee property is said to be earning a large surplus, which will accrue to holders of the proposed issue of North American preferred stock. It has been largely due to the efforts of Mr. Morgan and his friends that the Milwaukee road has been brought up from a condition which at one time seemed to threaten bankruptcy.

Special Correspondence.

NEW YORK NOTES.

DEATH OF CAPT. TILLY.—Capt. G. H. Tilly, of the Western Union Telegraph Company, who joined the Signal Corps and was serving in the Philippines, was killed by the insurgents while employed on cable work at Iloilo. He and his companions from the cableship Recorder were deceived by a false flag of truce.

AN ELECTRIC LAUNCH ON THE CENTRAL PARK LAKE.—An innovation is to be introduced on the lake in Central Park. An electrically-propelled launch will be placed on the water. The boat will be 36 feet long and have a carrying capacity of 40 passengers. The batteries will be recharged by current taken from the electric light wires running near the lake.

MR. L. E. BENNETT, of the American Trading Company, Bangkok, Siam, has been an interested visitor to the Electrical Exhibition. He is making arrangements here for electrical representation in the East of various concerns, and will be glad to hear from companies desirous of building up trade in the Orient. Mr. Bennett is a well-known man and is United States Vice Consul General at Bangkok.

A NEW NORTH RIVER TUNNEL.—There exists a belief that the Whitney-Elkins-Widener street railway syndicate contemplates the building of a tunnel under the North River between New Jersey and Manhattan Borough, New York. It is thought that the Manhattan Tunnel Railway Company, which was incorporated at Albany on May 17, with a capital stock of $10,000, with the privilege of increasing the same to an unlimited amount, is controlled by this syndicate. According to the incorporation papers of the company it is the intention to construct a tunnel railway of standard gauge operating by electric or other power for the transportation of passengers and freight. One terminus of the road is to be at some point below Canal Street in the Borough of Manhattan, and the other terminus will be in Jersey City. The directors and names in the papers are Frederick Martin Lande, Charles S. Bradley, William E. Knight, Arthur P. Knight, William A. Courtland, John P. Laflin, and David J. Newland, of New York City; James V. Hulse, of Brooklyn, and Philip W. Hall, of Cranford, N. J.

NEW ENGLAND NOTES.

AMERICAN ELECTRICAL WORKS, Providence, R. I., in honor of Memorial Day, has sent to its friends a souvenir portrait in small steel plate medallion of Gen. Grant, with a fly sheet containing data of his wonderful career.

MR. HENRY C. BUCK, long associated with Prof. Dolbear, of Tufts College, but now New England manager of the Wagner Electric Company of St. Louis, attended the Electric Light Convention and the Electrical Exhibition in New York, in company with General Manager Abadie, of the Wagner Company.

MR. PRESTON C. NASON, of Boston, one of the earlier workers in the telephone field, especially in the West Indies, but now and for the past three years vice-president and manager of the Magmul Mirror Company of New England, attended the Electric Light Convention and the Electrical Exhibition in New York. He sailed from New York last Saturday morning on the new steamer "Patricia" for a combined pleasure and business trip through Europe.

PHILADELPHIA NOTE.

ELECTRIC CLOCKS.—On May 23, Mr. James Hamblet, manager of the telegraphic time service of the Western Union Telegraph Company at New York, presented a communication to the Electrical Section of the Franklin Institute, entitled "Electric Clocks, Historically Considered; and the Uniform Distribution of Time." Electric clocks, Mr. Hamblet stated, were first invented in England by Alexander Bain and Sir Charles Wheatstone, about the year 1840 or 1841. Mr. Bain first used an earth battery for electric clocks, and Wheatstone used magneto electric currents to propel the hands of the clock. A Mr. Shepard in England made electric clocks about the year 1849. The first inventor on this side of the water was Prof. Moses G. Farmer, and after him Mr. Albert Hall, of Ohio, in 1854, brought out an electric clock. In 1860 Mr. Hamblet himself invented the electric watchman's clock for registering the duties of watchmen during the night. These clocks are still in use in Philadelphia. In 1864 Mr. Hamblet invented the first electric pendulum, a model of which was exhibited to the audience. The lecturer described a number of ingenious clocks made by Hipp, of Neufchatel, Switzerland. Touching upon the subject of distribution of time, Mr. Hamblet stated that the Western Union Telegraph Company distributes time from Maine to California. Twenty-three circuits run from the Western Union Telegraph Building in New York City controlling something like 1500 self-winding clocks, corrected every hour by the standard clock in New York. A self-winding clock was also exhibited. This clock is wound by electric power every hour, the batteries being renewed once every three or four years. Mr. J. D. Darling, of Philadelphia, also presented at the same meeting a communication entitled "An Improved Primary Battery." Both papers were discussed.

SOUTHERN NOTE.

THE RICHMOND TELEPHONE CASE.—The opinion of the Supreme Court of the United States, affirming the right of the city of Richmond to repeal the franchise of the Southern Bell Telephone Company, has excited a great deal of interest in that city. The feeling has been very strong against the telephone company on account of its arbitrary position, and the council is in favor of compelling it to leave the city regardless of the loss to the company. The company has at present about 1300 instruments within the city limits, and long-distance connections. In case it is compelled to remove its wires, poles and instruments, the community will suffer a great loss. The company's competitor, the Richmond Telephone Company, has been struggling with fair success against its formidable rival. Among the business men of the city there seems to be a regret manifested over the possibility of losing long-distance service, which is now so important to every city.

WESTERN NEW YORK NOTES.

THE ELWOOD ELECTRICAL COMPANY, of Rochester, has been incorporated, with a capital of $2500. The directors are Alfred Elwood, C. A. Elwood and W. I. Peacock.

THE BUFFALO & NIAGARA FALLS ELECTRIC LIGHT & POWER COMPANY, of Niagara Falls, has received the large generator built for it by the Walker Company. This generator will be attached to the turbine last installed in the station of the Niagara Falls Hydraulic Power & Manufacturing Company in the Niagara gorge.

AUTOMOBILES IN BUFFALO.—The contract between the city of Buffalo and the National Motor Transit Company was signed May 19. Under its provisions the city gives the company the right to run automobiles under a one-year franchise, through various streets and the park. The vehicles must run every 30 minutes until Nov. 1, and are expected to start service by Aug. 1. Gasoline vehicles will be tried first, and later on electric vehicles may be introduced. A $50,000 bond indemnifies the city against loss by suits.

PAN-AMERICAN EXPOSITION.—The site for the Exposition of 1901 has been selected and lies in the northern part of the city of Buffalo, about three and one-half miles from the City Hall. It consists of something over four hundred acres, including a portion of Delaware Park, Park Lake and the valley of Scrjaquada Creek to a point where it is navigable for small craft. The site is traversed by the New York Central Railway, and is within a short distance of the Erie and Delaware, Lackawanna & Western Railways; it is also reached by three principal street railway lines from Buffalo and several cross lines and two street railway lines from Niagara Falls. It may also be reached by canal boats from Erie Canal via Scrjaquada Creek. A topographical survey of the entire tract is being made by George A. Ricker. The Executive Committee is now considering a plan of organization for the Construction Department and also the selection of a director of construction. Prof. F. M. Taylor, of the University of Nebraska, has been appointed director of the bureaus of concessions and exhibits. Prof. Taylor was superintendent of agriculture and allied bureaus at the Omaha Exposition and has been engaged in much commission work for the United States in relation to foreign expositions.

PITTSBURG NOTES.

MR. G. F. GREENWOOD, consulting engineer of the Consolidated Traction Company, has been selected to be engineer in charge of the work of rebuilding and reconstructing the street car lines in Havana, Cuba. Mr. Greenwood will not commence his new duties until early in the fall. The old Havana lines are from 18 to 25 miles in length, but the New York syndicate of capitalists, which has recently secured control of the property, will entirely rebuild and extend them. The entire equipment will be furnished from the United States.

ELECTRICAL CONTRACTORS ORGANIZE.—The Association of Electrical Contractors, of Pittsburg, Pa., was recently organized by representatives of a score or more of firms. The purpose of the association is to enforce price rules in dealing with jobbers and to make operative other trade regulations for general benefit. Manufacturers and wholesale dealers are urged to use more discretion in the distribution of their catalogues and discount sheets, and, if possible, to withdraw their low list prices in catalogues and substitute therefor the old high list prices. The practice of sending out net prices or discount sheets to other than electrical contractors or supply houses is condemned. The interpretation of an "electrical contractor" is an electrical contractor who has an established place of business, has the proprietorship of a shop or store with electrical material visible to the public, cards advertising the fact to the public and a sign for the same purpose; one who thus represents the electrical industry by dealing in electrical goods and doing work for the general public and has a license from the proper authorities to do electrical work, if such license is required. Janitors or engineers in buildings employed by the owners or agents, though they may be practical and have a license, are not regarded as electrical contractors, as they do no work for the public. Officers of the association were elected as follows: E. D. Smith, of the E. D. Smith Electric Company, president; J. J. Miller, of the Miller Electric & Construction Company, vice-president; H. W. Cleland, electrical contractor, of Wilkinsburg, Pa., secretary, and I. Patterson, of Springer & Patterson, treasurer. The following named firms were represented at the meeting: Clayton Electric Company, James W. Hayes, Munson Electric & Plumbing Company, E. D. Smith Electric Company, James Brown & Co., R. A. M. Steele, Albert S. Eldridge, Langton Electric Company, George R. Matthew, Penn Electric Company, A. C. Fry, J. C. Fry, A. S. Jones, Miller Electric & Construction Company, Orr & Howe, Springer & Patterson and H. W. Cleland.

OHIO NOTES.

THE FOREST CITY ELECTRIC COMPANY, of Cleveland, has increased its capital stock from $25,000 to $100,000.

THE TOLEDO TRACTION COMPANY, of Toledo, has voluntarily increased the wages of all its employees 5 per cent.

THE PORTSMOUTH TELEPHONE COMPANY, of Portsmouth, Ohio, has been organized, with a capital stock of $50,000.

THE PEOPLE'S MUTUAL TELEPHONE COMPANY has been incorporated at Van Wert, Ohio, with a capital of $10,000.

THE MAUMEE VALLEY RAILWAY COMPANY, operating out of Toledo, is preparing to erect a large power house at Miami. It will be 90 by 100 feet in dimensions, and have a capacity of 1000-hp.

THE AKRON & CUYAHOGA FALLS RAPID TRANSIT COMPANY has let contracts for the reconstruction of its line between both those places. An entirely new right of way has been secured which shortens the line considerably and avoids several heavy grades.

LARGE ORDER FOR STORAGE BATTERIES.—Messrs. Sipe & Sigler, of Cleveland, Ohio, manufacturers of the Willard storage battery, are at work on what is said to be one of the largest orders for batteries ever placed. It is from the Western Union Telegraph Company, and calls for 3000 cells for immediate delivery.

MR. W. F. KELLY, general manager of the Columbus Electric Street Railway lines, has resigned his position to go with the Messrs. Emerson McMillin & Co. of New York. Mr. Kelly was formerly prominently connected with the Thomson-Houston Company, of Lynn, Mass., and is widely known in the electric street railway business.

FARMERS WANT TELEPHONES FOR FRANCHISE PRIVILEGES.—The Central Union Telephone Company, which is erecting a line from Ravenna to Cleveland, is having trouble with farmers along the line. At Streetsboro armed men are preventing linemen from working. They demand telephones in return for franchise privileges.

JUDGE RICKS, in the United States Court in Cleveland, on May 20, rendered a decision on the application of the Postal Telegraph Company for a right of way over the Big Four Railway from Cleveland to Indianapolis. The railway company filed a motion to dismiss the suit, which motion was sustained on the ground that a foreign corporation had no right under the laws of Ohio to appropriate the property of another corporation, for the reason that the laws limit such rights to Ohio corporations. The decision is an important one, since it may affect similar suits elsewhere. Under it private citizens may also contest the right of companies to erect poles on their property.

INDIANA NOTES.

THE MARION ELECTRIC COMPANY, Marion, Ind., with a capital of $120,000, has been incorporated. B. F. Burk is president and chief promotor.

THE NORTHWESTERN INDIANA TELEPHONE COMPANY, of Valparaiso, filed articles of association with the Secretary of state on May 22. The capital stock is $18,000.

THE ROTH GAS & ELECTRIC ENGINE COMPANY, of Indianapolis, filed articles of incorporation with the Secretary of State on May 20. The capital stock is $50,000. Directors, C. C. Roth, C. E. Barrett, B. F. Hough and F. H. Waterman.

THE NEW TELEPHONE COMPANY, at Indianapolis, has established a rule, requiring persons who are not subscribers, but occupying an office with a subscriber, with use of telephone, to pay $10 a year. This plan secures payment from the class benefited and enables them to have their names printed in the directory.

THE INDIANAPOLIS TRACTION COMPANY WINS.—At a mass meeting on May 19, at Logansport, it was voted to transfer franchises held by local promoters to the Indianapolis & Logansport Traction Company, giving the latter a complete right of way. The company will begin work at once. Local capital will be invested in a line leading north from Logansport.

LABOR PROSELYTING.—There is ill-feeling existing between the Central Union and the New Telephone Company at Indianapolis. The former charges the latter with proselyting among its employees and causing them, as soon as made proficient, to leave its employ and take service with the new company. The New Company is operated by experienced operators nearly all of whom formerly worked for the Central Union.

SUCCESSFUL CO-OPERATIVE COMPANY.—The Rushville (Ind.) Co-operative Telephone Company is an instance of successful mutual operation. It began business a few years ago with 60 telephones, and now has nearly 300, with more to add. It has outside connections with many of the towns and cities in that part of the state. A new switchboard is being added and the New Long Distance Telephone Company, of Indianapolis, will be connected with the local exchange. This will give service all over the state.

BLOOMINGTON STREET RAILWAY FRANCHISE.—William A. Pickens, representing a company of Indianapolis capitalists, has made application for a franchise to construct an electric street railway in Bloomington. The ordinance is drawn and will be passed at the council's next meeting. The proposition is to build lines from Clear Creek to Hunter Quarry district. Work is to begin as soon as the franchise is granted and the line to be completed in a year.

CHICAGO NOTES.

THE BOARD OF TRADE, Chicago, is putting in an independent private telephone system for the interconnection of the various offices. The system will be equipped with a 200 line S.-C. "Central Energy" switchboard and telephones.

PROPERTY OWNERS IN THE DOWNTOWN DISTRICT are trying to secure their electric light and power from the plants of their neighbors, and discontinue the service of the Edison Company. The plan is to run wires under the sidewalk and alleys and between buildings. A permit to run such wires under the sidewalk to connect two buildings on Dearborn Street, was recently asked for before the Committee on Gas and Electric Light, but City Electrician Ellicott opposed the granting of the permit on the ground that the city should get something in return for the privilege. The matter is now in the hands of a special committee for investigation.

BANQUET OF ELECTRICAL MEN.—Members of the electrical trade of this city to the number of about 50 held their annual banquet at the Grand Pacific Hotel a few nights ago. Mr. B. E. Sunny, of the General Electric Company, acted as toastmaster. Remarks were made by Messrs. E. C. Ferguson, the well known patent lawyer of this city; James Wolff, of the New York Insulated Wire Company; E. P. Ellicott, City Electrician; Charles E. Brown, of the Central Electric Company; B. J. Arnold and Mr. Ide, of the Ide Engine Company, of Springfield, Ill. Mr. Block, of the Siemens & Halske Electric Company, made some remarks on the subject of the automobile carriage, in the manufacture of which this company is now about to engage. Mr. H. H. Cutler, of the Cutler-Hammer Company, also made some remarks touching upon the success of Americans in the manufacture of electrical goods. This, he stated, was due to the fact that instead of manufacturing dozens of articles, as they do in Europe, Americans confine themselves to one specialty, and excel in that. Mr. W. F. Collins responded for the electrical press, and Mr. George F. Whyte, of Leschen, Macomber & Whyte, entertained the party. The meeting was concluded with the singing of "Auld Lang Syne."

THE CHICAGO TELEPHONE COMPANY.—Directors of the Chicago Telephone Company have decided to sell at once 6635 additional shares of stock, making the entire amount outstanding $5,000,000, the full amount authorized. They have also decided to recommend to the stockholders at the next annual meeting that the capitalization be increased to $15,000,000. The company has now under construction four or five buildings about the city, in which its branch exchanges are to be established, and is constantly increasing its list of subscribers. When authority is obtained to treble the capitalization at the annual meeting next January, shares of the new stock will be offered to stockholders at par from time to time as money is required for extensions and improvements. At the beginning of the present year the company had in operation 21,876 telephones, of which 17,514 were in Chicago and the balance in the ten counties of Illinois and Indiana in which the company controls the Bell patents. The company was organized in 1881 with an original capital of $50,000.

WISCONSIN NOTES.

THE MADISON ELECTRIC RAILWAY COMPANY will expend $7000 in improvements this summer. Mr. F. W. Oakley is president of the company.

THE REORGANIZED FOX RIVER ELECTRIC RAILWAY & POWER COMPANY, of Green Bay, is in possession of the former Fox River Electric Railway and the road is now being operated by the officers of the new company. The receivers, Thomas W. Spencer, of Milwaukee, and M. Joanes, of Green Bay, were released at a meeting of the stockholders.

THE WISCONSIN TELEPHONE COMPANY has leased the premises at 418 Broadway, Milwaukee, in which will be located the contract and construction departments, the former in charge of C. E. Nestor, chief contract agent, and the latter in charge of P. G. Reynolds, general superintendent of construction of the Erie system, and T. J. Gallagher, superintendent of construction of the Wisconsin system.

REDUCTION IN TELEPHONE RATES.—The Wisconsin Telephone Company, which recently passed into the control of the Erie Telephone & Telegraph Company, on May 18 announced a cut in rates of 15 per cent. The unlimited metallic-circuit service will be reduced from $125 per year to $8 a month for business houses, and on residence lines from $70 a year to $5 a month. A new four-party rate is quoted at $5 a month for business and $3 for residence instruments. A new special residence and business service, which will allow an unlimited number of calls, will be put in at $1 and $1.25, respectively.

ST. LOUIS NOTES.

THE STREET RAILWAY CONSOLIDATION BILL passed last week by the State Legislature will enable the Browns Bros.' syndicate lines to complete their consolidation. This was heretofore rendered impossible by the state law limiting the capitalization of corporations to $10,000,000.

THE KINLOCH COMPANY'S NEW SECRETARY.—Mr. C. K. Dickson Walsh has resigned from the office of secretary of the Kinloch Telephone Company, but it has no special significance. He was one of the original 21 who organized the company, and acted as secretary until the plant and service were established and everything in good working order. These things having been accomplished he resigned, but still remains as director and stockholder. Mr. H. Linton Reber, formerly assistant chief engineer, has been elected secretary in Mr. Walsh's place.

A PETITION for a new electric railway franchise was filed in the St. Louis County Court at Clayton last week. The road is to extend from Jefferson Barracks to Chain of Rocks, a distance of 25 miles, forming a belt line through the county just 1,000 feet west of the city limits. The promoters are Harry E. Wagoner, J. C. Jones and Aikman Welch, of St. Louis. The line is to be built over a private right of way, and will run funeral cars and freight trains, as well as transport passengers. The company agrees to file a penal bond of $10,000 to protect the county against damage during construction of the road, and to pay an annual compensation of $1000 during the life of the franchise, which is to be 50 years.

PACIFIC COAST NOTES.

A TELEPHONE LINE will be built from Oakland, Ore., to Cole's Valley, a bonus having been raised to assure its construction.

ELECTRIC IRONING PLANT.—The Electric Laundry Company, of San Francisco, recently installed an electric ironing plant, in which electrical heating is used altogether.

ELECTRIC POWER FOR SAW MILLS.—A corporation in Oregon is about to place electric saw mills in the forests of immense trees, which are found in the country tributary to Bay City, in Tillamook County. Water power will be utilized for generating the current required.

CANADIAN NOTES.

THE ENGLISH PACIFIC CABLE.—The British warship "Egeria," which is now in the harbor of Vancouver, B. C., will leave there within a few days to survey the route for the proposed Pacific cable. The "Egeria" will start from Vancouver, proceeding to Fanning Island and from thence to Australia.

THE HAVANA STREET RAILWAY FRANCHISE.—A report from Toronto, Ont., that Messrs. Mackenzie, Cox & Nichols have secured the street railway franchise in Havana, Cuba, and that the New York syndicate, in which Montreal capitalists are interested, had lost it on the production of proof of bribery, is denied by the representatives of the Montreal syndicate who hold the franchise, namely, Messrs. Hanson Bros., of Montreal, Quebec. Hanson Bros. operate the Havana street railway at the present time, and they give an emphatic denial to the statement respecting bribery. No such action as that described could be taken until such a charge was investigated by the courts which are not now sitting.

THE HULL ELECTRIC COMPANY'S BRIDGE BILL.—In the Railway Committee of the Dominion House of Commons, the bill to incorporate a company to build a new bridge across the Ottawa River from Kent Street, Ottawa, to the city of Hull, Quebec, has been defeated on a vote of 72 to 36. The contest was one of the most interesting during this session of the Canadian parliament, the fight being virtually a repetition of the struggle of the Hull Electric Company to gain connection for its cars to run into Ottawa. The bill

was opposed by the Ottawa Electric Railway interests and those involved in the construction of the interprovincial bridge now building between Ottawa and Hull at a point about a mile below the proposed Kent Street bridge. This is the third defeat the Hull Electric Company has sustained since 1896 in its attempt to get into Ottawa.

SALE OF WATER POWER.—The water power of the River Ottawa, opposite the township of Onslow, comprising the rapids and falls of Les Chute des Chats, including the islands connected therewith, situated in the province of Quebec, is to be sold at public auction at the city of Quebec by the provincial department of lands, forests and fisheries on June 8. The upset price is fixed at $20,000, and payment must be made in cash; a $5000 cheque being required as a preliminary from each bidder. The purchaser must bind himself to disburse in the way of improvements and development of the water power, within three years the sum of $300,000, at least. The Upper Ottawa Improvement Company is not to be disturbed in its logging and boom privileges.

THE MONTREAL ELECTRIC STREET RAILWAY COMPANY was supposed to have had a monopoly of that city's business in street railway matters, and this fact and the enormous increase of daily earnings, year after year, sent the stock to a dizzy height; a $100 share selling as high as $335 a fortnight ago. But the action of the Railway Committee of the Dominion Privy Council in giving the Montreal Belt Line Company an entrance into the city for both passengers and freight dispelled that idea, and in consequence the stock has dropped to $312. This opposition has aroused the street railway company's management to look after its monopoly in other directions, and negotiations are again on foot for the absorption of the Montreal Park & Island Railway Company, which has exclusive franchises from a number of suburbs. It reaches the city at four different points, and enters by a friendly arrangement over the Montreal Street Railway Company's line. But it is in a bad condition financially, and it is obvious that a change in the management might rupture this friendly arrangement. It is understood that it has been offered $800,000 for all its property and franchises, but it is holding out for a round million dollars. Such a purchase would dispose of a good slice of the new stock of the Montreal Street Railway, which at the last session of the legislature was given permission to increase its capital from $5,000,000 to $10,000,000 for the purposes of extensions, but has not yet found an opening for the extra five millions of increased capital.

General News.

THE TELEGRAPH AND TELEPHONE.

CEDAR RAPIDS, IOWA.—The Clear Lake Independent Telephone Company has been incorporated with a capital stock of $3,000.

AMES, IOWA.—The voters of Nevada, Iowa, have sanctioned the granting of a franchise to the Iowa Mutual Telephone Company.

SPARTA, ILL.—The Sparta Telephone Company has been organized with a capital stock of $5,000. The incorporators are J. Spronlin, M. Sproul and A. B. Sproul.

LIMA, OHIO.—The Independent Telephone Exchange at Wapakoneta has been purchased by Mr. L. M. Blume, president of the First National Bank of that place. Mr. Blume paid $10,000 for the property.

PITTSBURG, PA.—The Homestead Telephone Company and the Allegheny County Telephone Company, of Braddock, have combined, and Braddock and Homestead will be connected by telephone in a few weeks.

LESLIE, MICH.—The Leslie Telephone Exchange is the title of an organization recently effected here with a capital stock of $25,000. The incorporators are V. H. Grout, W. G. Stewart and W. F. Prescott, all of Leslie.

HART, MICH.—The Oceania Telephone Company has been organized to construct and operate telephone lines. The capital stock is $20,000, and the incorporators are E. J. Hilton, S. Van Curen and E. T. Hilton, all of Detroit.

POUGHKEEPSIE, N. Y.—The Poughkeepsie Police Department is to be reorganized, and among the improvements contemplated is a telephone system. Twenty-five police telephone stations will be provided on the various beats, and connected with the station house.

MOSHEIM, TENN.—The Mosheim & Lick Creek Telephone Company has been organized to build a telephone line in Greene County, Tenn. The capital stock is $440, and the incorporators are F. M. Bible, J. W. Cloyd, M. H. Kent, H. C. Myers, Noah C. Bible, all of Mosheim.

KNOXVILLE, TENN.—The Virginia & Tennessee Telephone Company, with a capital stock of $50,000, has been chartered at Bristol. It owns a number of exchanges in southwest Virginia and proposes to buy and operate a number of others, connecting at Bristol with the Peoples Telephone Company, of Knoxville, which operates in East Tennessee.

JACKSONVILLE, FLA.—The City Council has passed a bill giving the right to the Southern Bell Telephone & Telegraph Company to lay underground conduits in this city for its wires. The company is required to place its wires into these conduits in the business section of the city within two years. The measure also provides that all poles shall be removed as soon as the wires have been placed in the subways. The city is given the exclusive use of one duct in each conduit through which the police and fire alarm wires will be carried. The telephone company also gives to the city a sum equal to 1 per cent. of the gross annual receipts from its business in the city, and it grants the free use of ten telephones to the city.

WISCONSIN TELEPHONE CO.—The new construction work, to be done by the Wisconsin Telephone Company, will be in charge of P. G. Reynolds, general superintendent of construction of the Northwestern, Southwestern and Michigan Companies, who has just been appointed to a similar position with the Wisconsin Telephone Company. E. D. Trowbridge, for several years with the American Telephone & Telegraph Company, now superintendent of the long distance service of the Michigan Telephone Company, will have charge of the long distance service in Wisconsin. Mr. Trowbridge also takes charge of the long distance lines operated by the Northwestern Telephone Exchange Company in the states of Minnesota, North Dakota and South Dakota.

ELECTRIC LIGHT AND POWER.

MARION, IND.—The Marion Electric Company has been organized, with a capital stock of $120,000.

PANA, ILL.—The Consumers Electric Light Company, of this place, has certified to a dissolution.

MORGANTON, N. C.—By a majority vote the town has purchased the electric light plant in this place.

BROWNSTOWN, IND.—The Brownstown Water & Light Company, with a Capital stock of $8000, has been organized here.

SOUTH BEND, Ind.—A dam is to be built across the St. Joseph River at Berrian Springs, to furnish power for electric lighting at South Bend.

PASADENA, CAL.—The Pasadena Electric Light & Power Company has secured the contract to furnish 150 electrical horse-power to the Mt. Lowe Railway Company.

CHICAGO, ILL.—Mr. Thomas Burns, 5000 Halstead Street, Chicago, has ordered one 60-kw Western Electric generator installed in his building for light and power purposes. The work of installation is being done by the construction department of the Western Electric Company.

YONKERS, N. Y.—The Terrace City Improvement & Construction Company has been organized here, with a capital stock of $100,000, to furnish electric light in this city. The directors are Oren E. Wilson, of Albany; David L. Gluck, of New York City, and Fremont Wilson, of Yonkers.

TRENTON, N. J.—The Electric Automobile Manufacturing Company, with an authorized capital stock of $500,000, has been incorporated here. The company is empowered to manfacture and operate vehicles propelled by electricity or other power. The incorporators are Charles P. Scott, of New York, and Frederick W. Gaston and Edgar J. Runyon, of Elizabeth.

RICHMOND, VA.—Bids were opened on May 16 for the construction of dams, canal and power house foundations for the water power station of the Virginia Electrical Railway & Development Company, at Richmond, Va., and the contract was awarded to Winston & Co., Louisa, Va. The General Electric Company secured the contract for four 700-kw direct current, 500-volt generators.

WASHINGTON, D. C.—Messrs. Oscar T. Crosby, president of the syndicate of electric lighting companies of this city, and Charles A. Lieb, of New York, president of the Washington Automobile Company, have secured options upon the property on both sides of the Potomac River at Great Falls, with a view to the development and utilization of the water power. It is said to be the purpose of the company represented by these two gentlemen to establish an electric power generating plant at the point named, to cost about $1,000,000. It is thought that power can be transmitted to Washington, with a loss not to exceed 10 per cent. The new company will form a part of the street railway and lighting syndicate, and it is the purpose of the promoters to use the current for the operation of the various lighting and railway properties in the city.

THE ELECTRIC RAILWAY.

DETROIT, MICH.—The Detroit & Port Huron Electric Shore Line Company has been organized to construct and operate electric railways. The capital is $125,000, and the incorporators are Wolcott P. Robbins, John R. Truman, Henry P. Driggs.

LANCASTER, PA.—The Lancaster, Mechanicsburg & New Holland Railway Company has been chartered at Harrisburg to build an electric railway 12 miles long in Lancaster County. The company is capitalized at $150,000, and its president is Mr. William B. Given, of Columbia.

LEBANON, PA.—The Lebanon Valley Street Railway Company has secured the right of way for the construction of a line between Annville and Palmyra, a distance of five miles. Upon the completion of this work all but 15 of the 55 miles between Harrisburg and Reading will be covered by trolley lines.

ERIE, PA.—A street car line is to be constructed between Erie and Northeast, at a cost of $500,000. The following named gentlemen are officers of the company: President, E. T. Walker, Philadelphia; vice-president, W. E. Hayes, Erie; secretary, G. D. Howell, Philadelphia; treasurer, Isaac Walker, Philadelphia.

DULUTH, MINN.—Sympathizers of the striking street railway employees a few days ago made attempts to kill a non-union motorman. Six shots in all were fired at a car which was crowded with passengers. As another car was approaching Third Street, in West Duluth, it was thrown from the track by an explosion and partially wrecked. At last reports the strike was still on.

PROVIDENCE, R. I.—It is announced that the Warwick & Oakland Beach branch of the New York, New Haven & Hartford Railway has been transferred to the Union Railway Company, which operates practically all of the trolley lines in this city. It is the intention of the Union Company to substitute electric traction for the steam system now used on the newly acquired line.

PITTSBURG, PA.—Mr. G. F. Greenwood has resigned his position as general manager of the Consolidated Traction Company. He will not sever his connection with the company entirely, however. He will accept a position as its consulting engineer. He resigned his position as general manager to become engineer of the Sharpsburg Bridge and the Suburban Traction Company. The position of general manager of the Consolidated Traction Company has been abolished and Mr. Charles Fitzgerald has been appointed general superintendent and will have charge of the operation of the Consolidated Company's lines.

LEGAL.

INTERPRETATION OF THE GENERAL ELECTRIC-WESTINGHOUSE AGREEMENT.—Suit was begun in the Circuit Court of the United States, at Utica, for the northern district of New York last March, by the Westinghouse Electric & Manufacturing Company to enjoin the General Electric Company from delivering to the Edison Electric Illuminating Company of New York City, multiphase apparatus and rotary transformers covered by Tesla patents controlled by the Westinghouse Company. Both companies maintained that the differences had their origin solely in the varied interpretation of the contract entered into in 1896 between the companies providing for an exchange of licenses. Three years ago the companies entered into an agreement to allow each other to use their several patents under conditions restrictive of territory and customers. The allegation of the Westinghouse Company was that the General Electric Company had violated the terms of this agreement by contracting to furnish the Edison Electric Illuminating Company with the multiphase apparatus whereas the United Electric Light & Power Company, of New York City, is the exclusive licensee of the right to use this apparatus. The General Electric Company maintained that a different interpretation of the agreement allowed it to supply these generators to the Edison Company. It declared that it has sold such generators to the Edison Company before, it being a matter of common knowledge that these machines are now in use on the Edison circuits. The value set on the apparatus in dispute was given in the bill of complaint at $250,000. The "patent agreement" between the two companies provides for a practically perpetual interchange of patent rights and licenses. At Utica, on May 22, the dispute was decided in favor of the General Electric Company on the demurrer which it had filed as defendant, Judge Coxe holding in substance that the plaintiff had failed to sustain its case.

PERSONAL.

MR. E. T. WIGHTMAN, who has for some time past been the manager of the Dover, N. J., Electric Light Company, which he has reorganized and adjusted in various ways, has resigned that post, leaving the company in excellent condition. He is succeeded by Mr. F. C. Wright.

INSULL—WALLIS.—The marriage took place in this city on May 23 of Mr. Samuel Insull, president of the Chicago Edison Company, and the Illinois Electric Vehicle Company, to Miss Gladys Wallis, who has been starring for some time past with Mr. W. H. Crane's Company, and is well-known as a talented and beautiful young actress. A host of friends extend their warmest congratulations.

Trade and Industrial Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is handling the Willson Combination Alcohol Torch, which is a useful tool for electricians.

STANLEY WATTMETERS.—An encouraging demand for its wattmeter is reported by the Stanley Instrument Company, of Great Barrington, Mass., and an early extension of the works is contemplated.

THE INDEPENDENT CONSTRUCTION COMPANY has been organized in Detroit, Mich., to construct telephone lines, exchanges, etc. The capital stock is $5,000 and the incorporators are L. G. Gorton, J. C. Daugiger, A. C. Cowels, J. J. Brook.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, Indianapolis, Ind., has just issued a new circular, pointing out the features of and advantages in using its apparatus. It will take pleasure in mailing a copy of the same to anyone interested.

THE CHICAGO BELT LINE STREET RAILWAY COMPANY, of Chicago, Ill., has certified to a change of name to the Reagan Fuel Economizer Company, and to a change of object to that of selling heating apparatus and conducting general foundry and machine works.

THE WARREN-MEDBERY COMPANY, Sandy Hill, N. Y., it is stated, has closed an arrangement whereby it will move its plant to Ft. Edward, N. Y. The reason given for this contemplated move is that the company has outgrown its present quarters, and Ft. Edward offers superior advantages.

THE DETROIT SWITCHBOARD & TELEPHONE COMPANY, Detroit, Mich., has completed a 3000-line switchboard for the Peoples Telephone Company, of New Orleans, La. It has also received a contract for the construction of a 5000-line switchboard for the Allegheny Telephone Co., of Pittsburg, Pa.

MESSRS. CANFIELD & CO., of Columbus, Ohio, have opened an office, 613 the Wyandotte Building, and will carry on an electrical construction business, both private and municipal. They will represent various manufacturers of electrical goods. Mr. H. L. Canfield, of the firm, has had 14 years' practical electrical experience.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, reports meeting with a steadily increasing demand for its "Central Energy System." Among the orders received during the last few days were "Central Energy" equipments for Nashville, Ill.; Northwood, Iowa; Elizabeth, Pa., and Brookings, S. D.

THE AMERICAN ELECTRICAL COMPANY was recently organized in Cleveland, Ohio, and is carrying on construction work and manufacturing a line of switches on which it is securing patents. The firm, which is composed of Mr. K. H. Hexter, president and secretary, and J. E. Lloyd, general manager, has a capital of $1000. The address of the company is 38-40 Sheriff Street.

MR. J. DONNELLY, Branford, Conn., is manufacturing linemen's pole climbers with removable plugs and spurs. New spurs can be attached at any time without loss of time or expense of sending the climbers to the maker for repairs. The plugs are attached by rivets and can be applied in two minutes. Mr. Donnelly's climbers are made from special steel.

THE CARLISLE & FINCH COMPANY, Cincinnati, reports the searchlight business as very good. At present it is filling several contracts for large projectors for the United States Navy, and has orders for projectors for use on the Pacific coast and in Canada. The searchlights of this company are indorsed by the largest steamboat companies on the Ohio, Mississippi and other rivers.

MR. F. M. PRESCOTT, 44 Broad street, New York, has added an electrical department to his talking machine and novelty business. It is under the immediate charge of Mr. A. W. McLimont, formerly connected with the foreign department of the General Electric Company. Mr. Prescott himself is also an old General Electric man and was connected with that company's export department for several years.

MESSRS. CHARLES H. BESLY & CO., 10 and 12 North Canal street, Chicago, are the western representatives for and carry a complete stock of Pecora machinery paints which have been on the market, and given general satisfaction, since 1862. The Pecora blow-hole cement is something new. It stands under the planer, lathe, file and other finishing operations. It is gas and air tight and withstands a temperature of 200 degrees.

THE AMERICAN TIN-PLATE COMPANY has placed an order with the Westinghouse Electric & Manufacturing Company, of Pittsburg, for electrical apparatus to go into its large plant at New Castle, Pa. The order includes a 500-kw generator and a number of electric motors, aggregating several hundred horse-power. The motors will be used in all parts of the plant. The shears, cranes, punches, tinning machines and all the appliances for carrying on the tin-plate business in which power is required, will be operated on the new system.

THE AMERICAN IMPULSE WHEEL COMPANY, New York, has received information that a 36-inch water wheel, recently set up in the Massachusetts Institute of Technology, has in the first test, before the bearings were worn smooth, run over 80 per cent. efficiency, and that in design and finish it is highly satisfactory. The company states that wherever its wheels have been installed satisfactory results have been reported. It points to the fact that the testimonials bear evidence that its water wheels are superior in design, mechanical workmanship and efficiency.

THE SPRAGUE ELECTRIC COMPANY did not make an exhibit at the Electric Light Convention this year, but many of its Lundell fan motors and power motors were in evidence doing effective work for various exhibitors who felt the need of a comfortable breeze, or needed power to operate their exhibits. The Sprague Company says that it was too busy to get an exhibit in shape, or to spare the men necessary to take care of it. Although the weather up to the present time has not been particularly favorable to the sale of fan motors, the company reports that its sales so far are largely in excess of those for the corresponding period in any previous year. This is taken as a very favorable augury of a successful season.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, O., has shipped to England one 25-hp generator and two 30-hp, one 40-hp and two 50-hp printing press equipments for the Manchester "Sporting Chronicle," Manchester, England. Also one 25-hp type O printing press motor with controller to Cassell & Co., London; and a slow-speed motor for direct connection to a lithograph press will be forwarded to the "Belfast Evening News." A 30-hp printing press equipment with teazer and controller will also be sent to the latter paper. Two 50-hp motors with teazers and controllers will be dispatched to the London "Daily News." The company has on hand for execution several other English orders for motor equipments and generators. Among these may be mentioned two 40-hp slow-speed generators for the Thornycroft Shipbuilding Yards.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, in its Circular No. 50, just issued, describes the Chloride accumulator plant in the Criminal Court Building, in New York City. Illustrations are given of the switchboard, the battery room and the booster. The frequent night sessions of the court rendered it necessary to have a large number of lights ready for service at any moment of the night, and to accomplish this without the necessity of maintaining an extra night shift of men in the boiler and engine rooms, a battery of Chloride accumulators was installed. In this plant there are 71 cells Type G—29 plates Chloride accumulators. The plates are suspended in lead-lined wooden tanks, the outside dimensions of which are 31 inches wide, 20¾ inches long and 23⅜ inches high. The battery has a capacity of 1960 ampere-hours.

MESSRS. GATES & RANDOLPH have taken offices and warerooms at 13 and 15 Monadnock Building, Chicago, on the ground floor, formerly occupied by Sargent & Lundy. They are handling the apparatus of the Triumph Electric Company, of Cincinnati, Ohio, for direct current work; the Warren Electric Manufacturing Company, of Sandusky, Ohio, for alternating work; portable switchboard alternating and direct current instruments of the Empire Electrical Instrument Company, of New York; switchboards, circuit breakers and switches of F. A. La Roche & Co., of New York; and arc lamps for all circuits of the Sterling Arc Lamp Company, of New York. It is the purpose of the firm to operate a miniature electric lighting plant in their new warerooms, using a Triumph motor to run a Warren alternator through a La Roche switchboard, with Empire instruments and transformers, etc., with arc and incandescent lamps and motors running on the same circuit. Messrs. Gates & Randolph are old-timers in the electrical business, and will not only handle electrical apparatus, but undertake entire contracts for railway and lighting plants.

BULLOCK GENERATORS.—The Bullock Electric Manufacturing Company, of Cincinnati, Ohio, has adopted a conservative position in the rating of its machines, allowing an unusually large margin. The cause of the greater part of the failures in electrical machinery to-day is, it considers, the attempt on the part of some manufacturers to overrate their apparatus, owing to the fierce competition which some companies are called upon to contend against. The Bullock Company claims to occupy a unique position in this respect. By carefully guarding against the temptations to overrate its apparatus and by sparing no expense in the adoption of means to better its products, it has created a field of its own, in which no difficulty is found in disposing of its output at remunerative prices. The magnificent new shop into which the company has lately moved, and the large amount of new machinery that has been put in, has not yet enabled it to entirely catch up on orders, and it still reports that it dislikes to accept orders to be filled on short notice. The Bullock Manufacturing Company is represented in the East by the Bullock Electric Company, of New York, with offices in the St. Paul Building, and in the West by the Central Electric Company, 254 Fifth Avenue, Chicago.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MAY 23, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

625,321. SOCKET FOR INCANDESCENT LAMPS; A. A. Chaillet, Shelby, Ohio. App. filed Feb. 28, 1898. The lamp switch is so constructed as to be operated when the bulb is turned in the socket and each time the current is turned on the polarity is changed, the purpose being to increase the life of the filament. The metallic parts are all encased in insulating material and so arranged that arcing can only take place with difficulty.

625,354. DENTAL SPATULA; A. H. Putnam, Toronto, Canada. App. filed March 9, 1898. A pair of conductors passes through a tubular handle and connects with a heating coil in a socket at the forward end of the handle; this socket receives the shank of the tool; the handle also carries a push button for controlling the circuit.

625,364. ELECTRIC SIGNAL; J. M. Smith, New Orleans, La. App. filed April 30, 1898. The signal is designed for trolley roads. The trolley wheel strikes a tappet and opens or closes an electric circuit, which extends forward to a signal on the roadway and causes it to announce the approach of the car.

625,378. AUTOMATIC FIRE AND BURGLAR ALARM; S. H. Burkhardt and A. Kunkel, Johnstown, Pa. App. filed Dec. 19, 1898. A U-shaped spring arm is enclosed in a casing with a pair of electric contacts. The arm is normally held out of connection with the contacts by a cord. When the cord is destroyed by fire or pulled by a window or door, the spring is allowed to bridge the contacts and give an alarm.

625,395. SAFETY DEVICE FOR ELECTRIC CIRCUITS; Edwin J. Houston and Arthur E. Kennelly, of Philadelphia, Pa. App. filed March 26, 1898. (See Current News and Notes.)

625,431. ELECTRIC ARC LAMP; S. Bergmann, New York, N. Y. App. filed May 7, 1897. The outer globe is supported upon double telescoping rods, while the inner globe is supported upon single telescoping rods. To trim the lamp both globes are lowered, the outer globe passing below the inner.

625,432. ELECTRIC ARC LAMP; S. Bergmann, New York, N. Y. App. filed Feb. 17, 1898. To prevent chattering and vibrations of the upper carbon when the lamp is started up, springs are interposed between the carbon carrier and the armature which take up such movements.

625,451. UNDERGROUND CONDUIT; R. W. Lyle, Perth Amboy, N. J. App. filed March 22, 1899. A central passage extends longitudinally through the partition of the conduit; at each end of a section this passage is enlarged to the size of a dowel pin; the dowel pin enters the passage until it strikes the shoulder at the beginning of the narrow portion, the object of the invention being to provide for the use of the dowel pins without a middle flange.

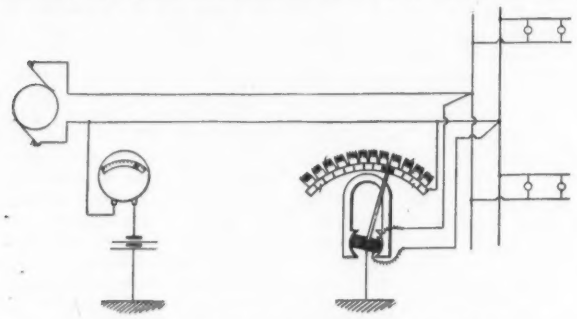
625,454. REGULATOR FOR ELECTRIC CAR MOTORS; Hiram S. Maxim, of London, England. App. filed Nov. 5, 1898. (See Current News and Notes.)

625,462. ELECTRODE FOR DRY STORAGE BATTERIES; Leonard Paget, of New York, N. Y. App. filed Dec. 30, 1898. (See Current News and Notes.)

625,473. ELECTRICAL ATTACHMENT PLUG; A. P. Seymour, Syracuse, N. Y. App. filed Feb. 9, 1899. The plug is made in two parts, one being an unglazed porcelain member to which are secured the metallic parts of the plug, and the other an externally glazed porcelain cover fitting over the first member to protect and insulate its metallic parts.

625,512. ELECTRIC RAILWAY; Robert Lundell, of New York. App. filed April 5, 1898. (See Current News and Notes.)

625,554. TROLLEY CONTROLLER; L. M. Halsey, New York, N. Y. App. filed Nov. 24, 1897. The trolley wheel is mounted in a lever pivoted between the arms of the yoke on the free end of the pole. The trolley rope extends from a spring actuated reel carried at the base of the pole through a guide on the harp to a point of attachment on the rear of the car. In passing through the harp the rope lies in such relation to the lever that so long as the trolley wheel is depressed by contact with the wire the rope may travel freely through the guide and allow the pole to rise and sink as required in following the wire, but, as soon as the wheel leaves the wire and rises relatively to the harp, the lever contacts with the rope and holds it firmly, thereby preventing any further rise of the free end of the pole.



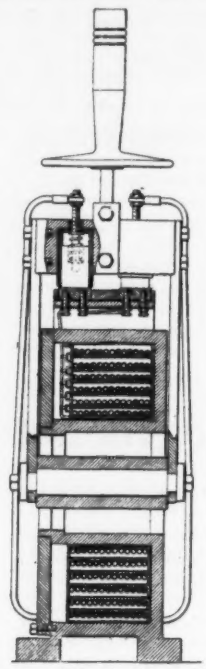
625,597.—Means for Ascertaining the Potential at Any Point upon Systems of Electrical Distribution.

625,559. SIGNAL REPEATER; T. B. Keeler, Rahway, N. J. App. filed April 21, 1898. This device indicates to the operator at a signal tower the condition of the semaphore arm located at a distance from the tower. The semaphore operates a pole changer in circuit with an electromagnet facing up a miniature semaphore arm, the latter being a piece of polarized metal.

625,566. MANUFACTURE OF ELEMENTS FOR SECONDARY BATTERIES. App. filed Nov. 25, 1898. (See Current News and Notes.)

625,571. AUTOMATIC CONTROLLER FOR ELECTRIC LIGHTS; O. M. Lacy, Hanford, Cal. App. filed Nov. 11, 1898. In the circuit with the lights there is placed an automatic make and break device, which in case more lights than a predetermined number are used, the said lights will be alternately lighted and extinguished in rapid succession.

625,597. MEANS FOR ASCERTAINING THE POTENTIAL AT ANY POINT UPON SYSTEMS OF ELECTRICAL DISTRIBUTION; S. E. Phillips and G. G. Tilden, Washington, D. C. App. filed March 6, 1899. A measuring instrument is placed at the desired point in the system of distribution and a responding instrument is placed at the generating station and connected to one of the mains and the earth through a battery. One or more sections of resistance in the battery circuit are cut in or out by the movement of the index of the measuring instrument.

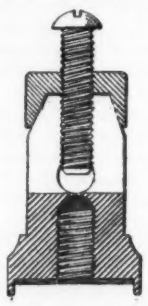


625,632.—Electric Controller.

625,599. ELECTRIC LIGHTING APPARATUS; Andrew Plecher, of Savannah, Ga. App. filed Oct. 4, 1898. (See Current News and Notes.)

625,632. ELECTRIC CONTROLLER; W. W. Adams and H. McGeorge, Cleveland, Ohio. App. filed Oct. 16, 1898. A rheostat consisting of a nest of cylinders of insulating material placed one within the other, upon each of which the resistance wire is wound; suitable arrangements for cutting in and out the sections are provided.

625,639. ELECTRICAL SWITCH; U. L. Berchel, Washington, D. C. App. filed Dec. 14, 1898. Details of construction whereby the switch may be opened and locked by a straight pull or push and then closed by a continuation of the motion in the same direction.



625,668.—Clamp or Connector.

625,668. CLAMP OR CONNECTOR; J. J. Gillaland, Adrian, Mich. App. filed June 10, 1898. A post has a lateral passage for a wire and a vertical passage for the screw, which bites the wire and holds it in place. This screw is locked by means of a set nut in the shape of a cap having a conical interior which screws down upon the upper end of the post and clamps it against the wire holding screw, the upper end of the post being split to permit of this clamping action.

625,683. ELECTRODE FOR SECONDARY BATTERIES; Jules Julien, of Brussels, Belgium. App. filed Oct. 24, 1896. (See Current News and Notes.)

Valuable Books for Telephonists.

THE ELECTRIC TELEPHONE; by E. J. Houston, Ph. D., and A. E. Kennelly, Sc. D. 12mo, cloth, 422 pp., 142 illustrations. Price $1.00.

This book describes the construction of the various forms of transmitting and receiving devices, the signalling mechanisms, and the switchboard apparatus at the central station. It is written by two well-known electricians, and has the merit of being the latest work on the subject.

THE PRACTICAL TELEPHONE HANDBOOK; by Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.

In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. Whilst the requirements of telephone employees have been kept constantly in view, it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

THE TELEPHONE HANDBOOK; by Herbert Laws Webb. 16mo, 150 pp. Price $1.00.

This handbook is not a complete treatise on telephony, but a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

TELEPHONE TROUBLES AND HOW TO FIND THEM; a complete handbook for telephone inspectors. By W. H. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Sixth edition. 16mo, 50 pp. Price 25c.

This little volume is an extremely practical work for telephone employees, written in a popular style and devoid of technicalities.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp., 168 illustrations. Price $2.00.

A MANUAL OF TELEPHONY. A new and enlarged edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pages, 333 illustrations. Price $4.50.

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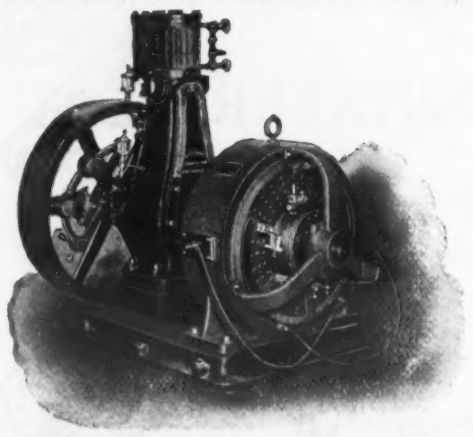

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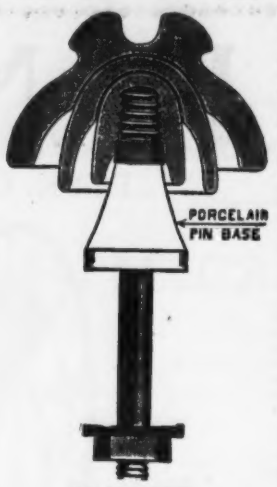

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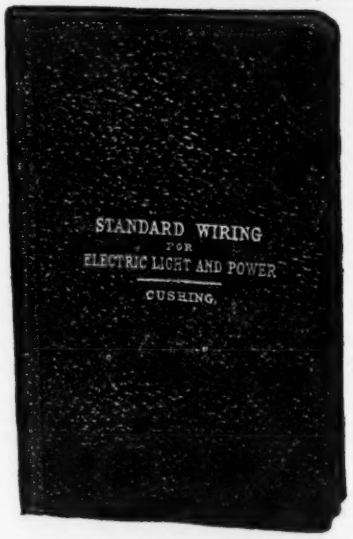

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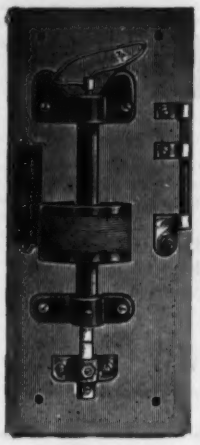

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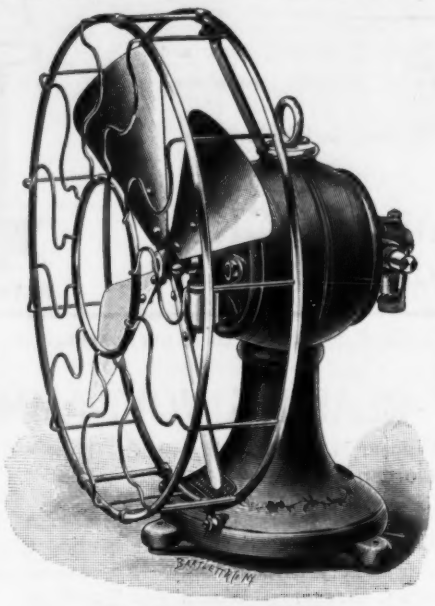

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